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The Impact of Policy in African Agriculture

An Empirical Investigation

William Jaeger

Policy in Sub-Saharan African countries is linked with the region's agricultural performance. Exchange rate policies, high taxes on agriculture, and government control of export marketing are associated with the deterioration in agricultural export performance in 1970-87. And the policy reforms of the late 1980s — where sustained and effective — are linked with increased agricultural productivity.

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This paper is a product of the Trade and Finance Division, Technical Department, Africa Regional Office. Copies are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Azeb Yideru, room J3-080, extension 34663 (69 pages, with figures and tables).

Jaeger examines the relationship between government policy and agricultural performance in Sub-Saharan Africa between 1970 and 1987. Using newly compiled data enabling a wider range of empirical analyses, the study assesses the impact of policy distortions on productivity over time and across countries. It assesses export agriculture and food production separately.

The analysis confirms that the deterioration of Africa's agricultural exports during the 1970s and early 1980s was associated with agriculture's high levels of direct taxation and of indirect taxation through government controls and overvalued currencies. Government controls in the marketing and pricing of export crops have contributed to the deterioration in export performance. But the large *indirect* distortions and disincentives caused by exchange rate policies are what have distinguished African policy environments from those in non-African developing countries. Econometric results show that the responsiveness of agricultural exports to changes in incentives is moderate in the short run for countries exporting tree crops but more elastic in countries exporting annual crops.

The author also investigates Africa's chronic food crises and questions the conventional wisdom that rising food imports and declining per capita production reflect primarily a production problem. Econometric results indicate that most of the rise in Africa's food imports is associated with shifting demand toward imported foods, rather than a failure of supply. The main factors causing the shift in demand are increasing urbanization, higher import capacity, and exchange rate distortions that make imported food relatively cheap. When the variation of these factors has been taken into account, the remaining unexplained trend is only 1 percent a year, caused in part by declining international prices for wheat and rice.

Jaeger establishes a link between policy reforms and the improvements observed in agricultural performance in the late 1980s. Countries with favorable policy environments have performed better in the 1980s, on average, than those with unfavorable policy environments. This has been true both in agriculture and in overall economic growth. And in countries where policy reform programs resulted in significant and sustained improvements in incentives (for example, Ghana and Togo), productivity has improved substantially. But in countries where reforms have not led to improved incentives or where the improvements were short-lived (for example, Tanzania and Zaire), little response was observable.

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FOREWARD

The last two decades have witnessed decline in Africa's agricultural exports and a sharp rise in the region's food imports. With over 70 percent of Africa's people dependent on agriculture for their livelihood, getting agriculture moving in Africa is one of the most important and formidable challenges facing Africa in the 1990s. There is now wide recognition that government policies have contributed to Africa's crisis and that policy reforms can help foster restored growth.

"The Impact of Policy on African Agriculture: An Empirical Investigation" examines the link between government policy and agricultural performance across countries and over most of the past two decades. The analysis confirms that governments' agricultural pricing and marketing arrangements and their macroeconomic policies have slowed agricultural growth. In particular, overvalued currencies have often caused the largest distortions. Recent trends, however, offer evidence that policy reforms have helped improve agricultural growth where these reforms have sustained agricultural procedures.

The author also offers evidence that government policies have been substantially responsible for Africa's growing food imports, by encouraging urban migration and by lowering the prices for imported foods relative to domestically-grown foods.

This study contributes to a better understanding of the causes of Africa's agricultural crisis and can help forge a consensus on how to restore vitality in African agriculture. This work was carried out as part of the World Bank's ongoing monitoring of Africa's economic growth and policy reforms.

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EXECUTIVE SUMMARY

Africa's loss of world market shares for its major agricultural exports and the decline in food production per capita are the most telling signs of stagnation and decline in Africa since 1970. Africa's international market share for its 12 major agricultural commodities fell by half between 1970 and 1983. Over the same period, per capita food production fell about 1 percent per year. Since the mid-1980s, however, there have been improvements in both food and export agriculture, a reversal which has coincided with the implementation of policy reform programs by a substantial number of African countries.

This paper examines the impact of policy on agricultural performance in Sub-Saharan Africa in the 1970s and 1980s. Based on recently available data enabling a wider range of detailed empirical analysis, the study assesses the distorting effects of government policies on incentives, the impact of those distortions on agricultural performance, and the changes over time and across countries in both policies and agricultural performance. Export agriculture and food production are assessed separately.

Africa's agricultural export performance deteriorated substantially from 1970-84. The pattern of decline -- and partial recovery in the late-1980s -- follows closely the high levels of distortion in the agricultural sector. These distortions were the result of both direct government controls on producer prices for Africa's principal export crops and the indirect effects of exchange rate policies. As a result of these policies, real producer prices fell by one-fourth between the early 1970s and early 1980s. The share of these crops' value retained by farmers (as measured by the real protection coefficient) dropped from about 90 percent to about 50 percent, on average, from 1971 to 1983.

Government controls and involvement in the marketing and pricing of export crops has been responsible for a considerable share of the deterioration of producer incentives, although the magnitude of these distortions has not been larger, on average, than in other non-African developing countries. However, large *indirect* distortions and disincentives have been caused in Africa by the prevalence of highly overvalued currencies, especially from the mid-1970s to mid-1980s. The large size and prevalence of these indirect distortions contrast with conditions in non-African developing countries. Pegged exchange rate regimes, coupled with poor fiscal management and high domestic inflation, resulted in highly overvalued currencies. Those countries which maintained grossly overvalued currencies over extended periods experienced severe deterioration of export agriculture. CFA-zone countries have been more successful in avoiding large exchange rate distortions over the period, and thus have been less affected by the deleterious effects on agricultural growth. In the late 1980s, however, overvaluation of the CFA franc has become more of a problem.

There has been considerable debate in the literature on the responsiveness of agriculture to price incentives in Africa. The issue is addressed here in an econometric framework combining cross-section and time-series data. In the short-run, tree crops exports are shown to be only moderately responsive to changes in price incentives. Elasticities are on the order of 0.1. However, for countries exporting annual crops the short-run response is more elastic, above 0.9. Exports are also shown to be responsive to changes in the real exchange rate, reflecting the effects on price incentives and on efficiency caused by changes in exchange and trade restrictions that generally accompany overvalued currencies. Elasticities of export supply with respect to the real exchange rate varied from 0.1 to 0.3 for tree crop exporters, and 0.6 for annual crop exporters. These estimates may not, however, reflect long-run responses, which are influenced by *expected* prices.

The possibility that export agriculture may crowd out food production is examined. Growth in export agriculture does not appear to come at the expense of food production. Food production is positively correlated with export crop prices and real exchange rates suggesting complementarity. However, lack of data means that the impact of policy on food production in Africa cannot be analyzed in the same way as export agriculture. Food production data are often questionable. Market price data for food crops are unavailable for most African countries. Because many African governments fix official prices for food, only those prices are generally reported and often do not correspond to actual market prices. However, the impact of policy on Africa's food problems can be examined indirectly.

Average food supply per capita has not declined in Africa since the 1960s. Food supply per capita - according to FAO data -- has risen slightly, on average, suggesting that only the composition of consumption has shifted from domestically-grown foods to imported foods (which are often preferred, especially among urban and wealthier consumers). However, Africa's chronic food crisis is commonly assumed to be both widespread and worsening, as evidenced by declining food production per capita and rising food imports. It is generally assumed that weak domestic production creates a need for more imports. The causal direction between imports and domestic production may be the reverse: that is, a shift in demand toward imported foods may have resulted in increased consumption of imports, and therefore reduced demand for domestic foods. This weak demand then led to weak domestic output. Demand for imported foods may rise due to urbanization, import capacity, and the relative price of imported to domestic foods (which will be affected by real exchange rates). Indeed, the doubling of Africa's food imports in the late-1970s was largely the result of events in Nigeria, which accounted for 70 percent of the increase. This occurred during Nigeria's oil boom when there were large shifts in import capacity (a quadrupling), the real exchange rate, and urban migration.

To test the hypothesis that both rising food imports and declining domestic production is demand driven rather than the result of a production constraint, an econometric model is estimated. The results confirm that much of the rise in Africa's food imports can be attributed to urbanization, import capacity, and exchange rate distortions. When these factors have been taken into account, the remaining trend is only 1 percent per year, and this can probably be explained by the declining international prices for wheat and rice over the period.

Rural-urban migration, which appears to be a cause of rising food imports, is a result of government policies, including exchange rate policies that have altered the internal terms of trade in favor of urban areas. Evidence of the extent to which urban migration is influenced by policy -- and the potential for policy reform to alter existing migratory patterns -- is demonstrated with recent data from Ghana. Survey data confirm what has been observed anecdotally in several African countries: significant reverse migration is occurring from non-agricultural to agricultural occupations since the introduction of Ghana's reform program.

The improvements in aggregate patterns of production and trade in Africa since the mid-1980s coincide with the implementation of structural adjustment programs in a large number of African countries. To assess the evidence of a causal relationship, economic performance in countries where policy distortions have been relatively small, is compared to that in countries where policy distortions have resulted in an unfavorable policy environment. In aggregate, countries with favorable policy environments have performed better in the late-1980s than the countries with unfavorable policy environments in virtually all measures of economic performance, including agricultural production, agricultural exports, and overall economic growth. The experience in

individual countries has been quite disparate, but in countries where policy reforms have resulted in significant and sustained improvements in incentives (e.g., Ghana, Togo) productivity has improved substantially. In countries where these reforms did not improve price incentives, or where the improvements were shortlived (e.g., Tanzania, Zaire), no significant response was observed.

Overall, the evidence from this study suggests that poor policies have had a major role in the decline of African agriculture. Similarly, there is evidence that policy reforms in the 1980s have contributed to some modest improvement.

There has been considerable debate about the scope for policy response in Africa, at times framed in terms of whether price or nonprice factors constrain growth most. The debate may be misleading, however. First, the distinction between price and nonprice factors is sometimes blurred; nonprice constraints on agriculture may be seen as being price related (e.g., the lack of roads implies high transport costs; the absence of extension services raises information costs of new technology). Second, the relative importance of price and nonprice factors will vary from country to country; therefore the debate of their relative importance must take account of specific country contexts. And third, the classification of constraints into price- and nonprice-related is to a large extent analogous to the dichotomy between short-run and long-run response to prices. For example, bad roads, lack of irrigation, poor institutional infrastructure, and other "nonprice" constraints may be the result of neglected investments caused by policy distortions which have made socially profitable investments privately unprofitable. Investments that would remove nonprice constraints may become attractive when policy distortions altering relative prices are lessened.

I. INTRODUCTION

Objective of the study

The responsiveness of Sub-Saharan African 1/ agriculture to changes in farm prices and macro-policies has emerged as a critical issue for understanding Africa's poor agricultural performance as well as for prescribing corrective actions. Views on the importance of pricing policies vary widely, and a debate has emerged recently about the relative importance of price and "nonprice" factors both in explaining Africa's poor performance and as the main impediment to recovery. Surprisingly little empirical work has been done, however, on aggregate agricultural supply response in Africa. This has been due at least in part to data limitations that have prevented extensive cross-sectional and time-series analyses.

Recently, however, suitable data have been compiled to enable a wider range of more detailed empirical analyses. Based on these data, the objectives of this paper are: a) to examine the trends and magnitude of policy distortions in Africa and their effects on agricultural incentives; b) to estimate the responsiveness of African agriculture to these policy changes; c) to assess the relative importance of these policies in explaining African's poor agricultural performance both for food and export crops since 1970; and d) to evaluate the evidence of a link between Africa's policy reform programs and recent evidence of recovery in Africa's agricultural growth.

Within the agricultural sector, exported crops and food crops have features that make it difficult to address them jointly. Analysis of food policy and growth gives rise to a variety of distinctive characteristics and problems due to the nature of government policies, the importance of domestic demand, and especially data limitations on producer food prices. Given these complexities, export and food crop agriculture are examined separately below.

Background

Agriculture is Africa's most important sector, accounting for about 80 percent of employment and 50 to 90 percent of exports. The sector has performed poorly since 1970: food production has failed to keep pace with population growth and export agriculture has experienced declining market shares. This slow growth and loss of competitiveness in international markets coincided with increasingly distorted macroeconomic policies and intensified government controls and restrictions (World Bank 1989a). Furthermore, in the late 1970s, exceptionally high commodity prices for Africa's major exports (oil, tropical beverages, phosphates) led to unrealistic expectations, overextended borrowing, and an unmanageable debt burden. The substantial imbalances on external and domestic public accounts created during this period eventually compelled many African governments to adopt macroeconomic policy reform programs. Declining revenues from agricultural exports and rising food imports led to the inclusion of agricultural sector reforms in many of these reform programs.

Most of these reform programs were initiated during the first half of the 1980s. And beginning in 1985, agricultural performance and agricultural export market shares began to show signs of recovery, with agricultural production growing at 4 percent per year from 1985-88 -- faster than population growth for the first extended period since 1970 (World Bank 1989a). These patterns have heightened interest -- as well as the debate -- on the merits and limits of policy reform as a basis for recovery in Africa.

1/ Throughout the paper "Africa" is used to donate Sub-Saharan Africa.

Conceptual Framework

It is generally agreed that agricultural growth is linked to farm profits - where farm profits are affected by a range of factors including government policy. Output prices, input costs, and exchange rates are central to most discussions of the responsiveness of agriculture to policy, but since farm profits are affected by wages, interest rates, market imperfections, information, etc., these factors need to be taken into account as well (Binswanger).

Government policy can affect farm profitability through a) control over output and input prices, b) taxation or subsidies that affect those prices, c) controls on wages and interest rates, d) institutional arrangements (e.g., access to credit, inputs, information), and e) actions that affect profitability and productivity in other sectors.

Direct government policies, including price fixing for products or inputs, or the taxation of their trade, affect the profitability of farming directly, and result in the shifting of resources between crops, or in moving resources out of agriculture into other sectors.

Macroeconomic policies affect farm profits in several indirect but critical ways. Nominal exchange rates set an upper bound on the price paid to farmers for exported commodities (less transport and processing costs, and net of subsidies). In the same way, exchange rates (together with import taxes and other restrictions) set prices of inputs and agricultural imports which compete with domestic production.

Overvaluation of the exchange rate can result in severe welfare and efficiency costs, both directly from the misallocation of productive resources, and indirectly as a result of the exchange and trade controls that usually accompany overvaluation. These indirect effects from trade and exchange controls can be the biggest costs associated with overvaluation (Edwards 1989a). In addition, such controls generate unproductive resource use from rent seeking activities.

An appreciation of the real exchange rate (or raising the relative prices of nontradables to tradables) raises the cost of producing tradables in terms of nontradables, and therefore reduces directly the profitability of producing these goods. Moreover, the shifting of the internal terms of trade against agriculture will encourage migration from rural to urban areas due to the loss of competitiveness of agriculture and growth in demand for nontradables, as well as from protection of urban-based manufacturing. Migration may occur as a result of other policies too, such as the provision of cheap food and other services for urban populations.

In addition to pricing policies and macroeconomic policies, government expenditure and investment in the agricultural sector can have important effects on farm profits and are critical to long-term competitiveness and agricultural growth. By and large these policy measures are aimed at reducing costs of production in order to raise profits and stimulate growth: construction of transport infrastructure will lower transport costs thus reducing input prices and raising output prices at the farmgate; extension services can be seen as reducing the costs of information (that are otherwise unavailable at almost any reasonable price); rural credit institutions make credit available at a lower cost to farmers; and research strives to raise profits by way of technological change. Factors affecting farm profits of this type are sometimes referred to as "non-price factors."

The macroeconomic policy environment that has led to real exchange rate appreciation is generally characterized by internal as well as external imbalances. High inflation, negative real interest rates, and restricted access to credit add to the harmful effects on investments in

agricultural as well as non-agricultural sectors. To the extent that agriculture is not a protected industry, the adverse effects on investment will be even larger.

Government intervention in marketing of farm products and inputs affects farm profits when these institutional arrangements result in inefficiencies, delays, fragmented markets, or inflated costs that depress producer prices. And governments intervene in other areas that affect farm profits as well, such as in land tenure policies or the allocation of newly productive lands (eg. irrigated).

In addition to policy measures aimed at promoting agricultural growth, governments intervene in the interests of consumers (price levels and stabilization), and to raise revenues (taxation of agricultural exports is an important source of revenue in most African countries). These two types of policies have distributional consequences between rural and urban peoples, and between export crop and food crop producers.

Most African governments exercise some control in the marketing and pricing of export crops, fixing prices in most cases, although so[illegible] have recently liberalized these markets. Major food commodities, both domestically produced and imported, have come under government control for reasons of price stabilization, keeping prices low for consumers, and to prohibit excess profits and control of markets by private traders. Cheap food policies, although common in Africa, have been difficult to enforce in most countries, giving rise to large parallel markets, and making officially announced prices often of little relevance to producers.

II. THE IMPACT OF POLICY ON AGRICULTURAL EXPORTS

Trends in Prices, Policy Distortions, and Exports

Africa's loss of world market shares for its major agricultural exports is the most telling evidence of its loss of competitiveness. Africa's share of those markets for its 12 major agricultural exports fell by half between 1970 and 1983. And the volume of agricultural export actually declined as well, falling from 14 million metric tons to about 11 million over the same period. 2/

As figure 1 confirms, the average pattern across 26 countries where complete data are available suggest that the loss of competitiveness in international markets has followed closely the pattern of overvalued exchange rates (real effective exchange rate index is inverted for better visual presentation), and lower real producer prices. For these 26 countries, only after exchange rate distortions began to decline and real prices paid to farmers began to rise in 1984, did export volumes improve.

The decline and recent recovery of agricultural exports appears to follow closely the pattern of real effective exchange rates over the period, except for 1987. Real producer prices have generally followed a similar pattern, although declining more slowly in the mid-1970s due the boom in international coffee and cocoa prices. The decline in export volumes in 1987 is primarily the result

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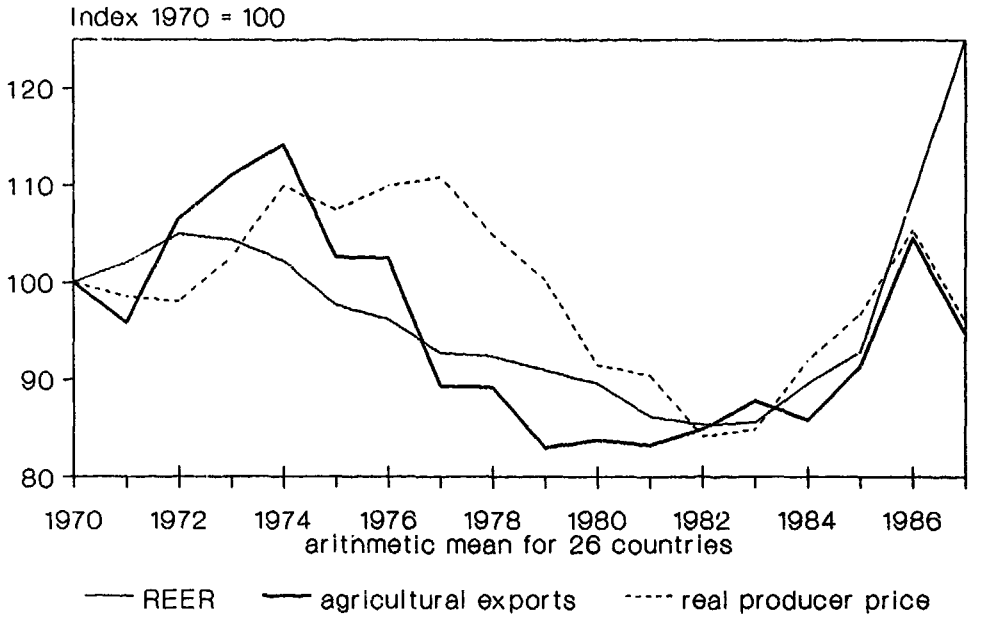
2/ FAO weighted average export volumes for total agricultural commodities. Much of the analysis is focused on export volumes rather than agricultural production. Agricultural production data is of questionable quality given the rough estimation procedures relied on for most countries. Since for most export crops domestic consumption is small relative to the total exported (cocoa, coffee, tea, rubber, tobacco, cotton), export volumes can be takes as a proxy for total production for most of these crops.

Figure 1. Policy, incentives, and agricultural exports in Sub-Saharan Africa



of lower output among major coffee growers. Exports rose in 1988 according to preliminary data available at the time of this writing.

Direct pricing policy distortions. A variety of government actions can affect producer prices directly (fixing prices, export taxes, marketing arrangements, etc). The net effect of which is often complex. To assess the magnitude of the collective distorting effects of these policies, some kind of measure is needed to capture the net effect of these complex interventions. The most commonly used measure of the distorting effects of policy is the nominal protection coefficient (NPC) -- or ratio of producer price to border price adjusted for marketing costs -- which compares what a farmer receives to the maximum he could receive short of subsidies (an NPC less than one indicates a tax on producers, an NPC greater than one would reflect a subsidy). NPCs have been widely used to assess the effect of policy on agricultural incentives, as a relatively simple means of assessing the divergence of producer prices from what they would be in the absence of government policies. 3/

Figure 2 indicates that NPCs for Africa's major exports have fallen and risen twice since 1970, and are now at a level of about 1.0, on average, but having fallen below 0.5 in 1976. The range of NPCs varies widely among countries and over time (see Annex D tables 1 and 2), from as low as 0.16 for Ghanaian cocoa in 1976 to as high as 2.6 for Senegalese groundnuts in 1987. In most countries the NPC varies erratically from year to year because producer prices are usually set at the beginning of the growing season, long before the international price that will be received for their production in the following year is known. 4/ Only in the few countries where the producer price is based on what is eventually received for their product (using a rebate system) as in Kenyan and Ethiopian coffee, and Malawian tobacco, are the NPCs more stable across years.

The degree of taxation implicit in these NPCs is in many cases substantial. However, it does not appear to be significantly higher during this period than in other developing regions when compared to those estimates (Binswanger and Scandizzo; Krueger, Schiff, Valdes).

Macroeconomic policy distortions. The NPC as a measure of policy distortion suffers, however, from at least two important drawbacks. First, the NPC does not take account of exchange rate misalignment or the implicit taxation that it can represent, and thus will understate the degree of agricultural taxation when exchange rates are overvalued. And second, changes in the NPC over time arise from three sources, but the relative importance of any one factor relative to the net

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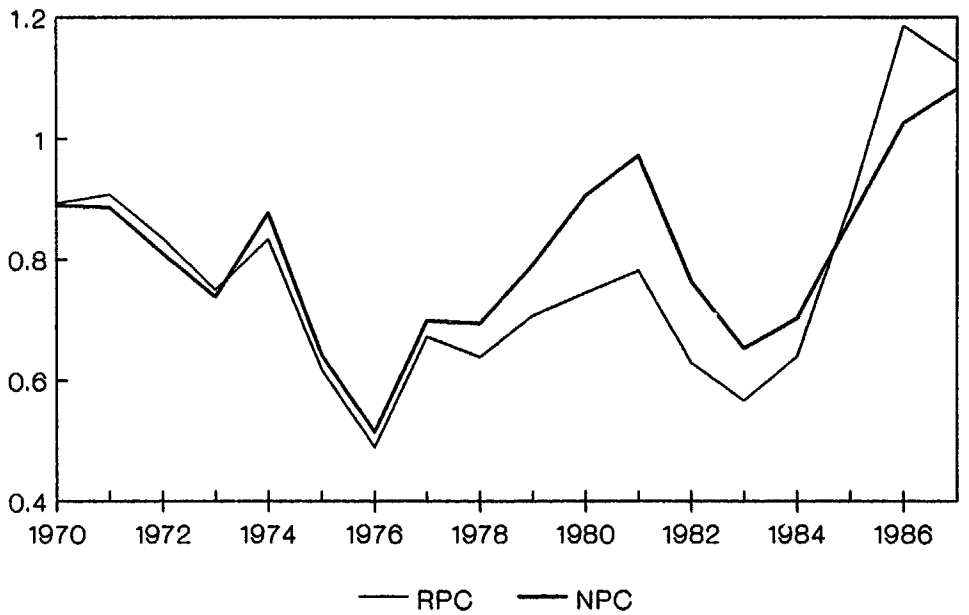
3/ A broad range of agricultural and macroeconomic data for 1970 to 1988 were used to examine policies, incentives, and performance for up to 40 African countries (see Annex A for details). The time period being considered and the number of countries involved lends itself to an analysis of cross-sectional and time-series data. NPCs for each country's major export and food crops have been computed as the ratio of producer price to border price net of all processing and marketing costs. Both numerator and denominator are adjusted to reflect the comparison of producer to border prices at the "last joint marketing point" (Westlake); the border in the case of exports, and the major consumption center for import substituting food crops. See Scandizzo and Bruce (1980) for computational details.

4/ The wide swings in NPCs from year to year explains, in part, conflicting findings in the literature as to the degree -- and direction -- of policy distorting effects in a particular country. Unless such studies are comparing producer prices and international prices for the same year, significant differences are likely to occur in the conclusions. Given these wide variations over time, multi-year analyses are advisable.

Figure 2. Nominal and real protection coefficients for major agric. exports



effects is ambiguous. Taking account of these effects is important, especially because exchange rates across Africa became highly overvalued during the 1970s, and have become less overvalued in the 1980s.

Both limitations of the NPC are addressed here, first by computing "real protection coefficients" (RPC) to take into account changes in the degree of currency overvaluation using the real exchange rate, and second by "decomposing" the annual changes in these RPC's in order to reveal the source of the changes because of changes in producer price, international price, or exchange rate.

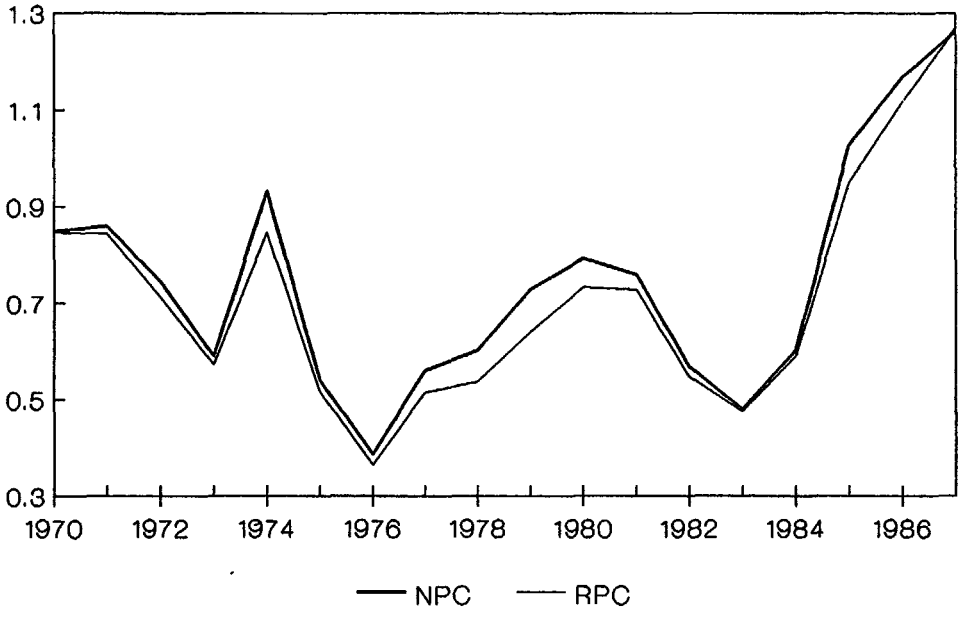
The RPC is computed by adjusting the NPC for changes in the real exchange rate, using 1970 as a base year. 5/ The RPC will diverge from the NPC to the extent that the implicit taxation from exchange rate policies has changed. 6/ Given the extent of exchange rate misalignment that has occurred among African countries, the RPC offers a better means for assessing how changes in policy have affected agriculture (See Annex Table 3). Figure 2 depict both the NPC and RPC from 1970 to 1987. The two are equal by definition in 1970, but diverge significantly between 1978 and 1984 indicating an increase in the degree of exchange rate misalignment. The difference is quite large, accounting on average for 20 percent of the producer's fair value of his production, and making clear that the rise in the NPC in 1980-81 was really a "false improvement" whereby a higher share of the border price (converted at the official exchange rate) was being received by producers, but at the same time the indirect effects of increasingly overvalued domestic currencies reduced agricultural competitiveness in a less direct but potentially more distorting way.

The differences between the NPC and the RPC is quite large in those countries where exchange rate misalignment had become severe: an NPC of 2.8 compares to an RPC of 0.51 for Ghanaian cocoa in 1981; in Uganda the NPC for coffee is 1.51, while the RPC is 0.17 in 1980. For CFA countries which historically have kept exchange rates in better alignment, the differences are small (less than 0.1), with some divergence during 1977-81 and 1985-86 (figure 3). The divergence in 1985-86 appears to have diminished in 1987, the result of a decline in the average REER in 1988 for CFA countries due to the strengthening of the french franc vis-a-vis to U.S. dollar.

5/ Both the NPC and RPC are computed for split crop years (i.e. 1970/71), so that the producer prices for 1970 crop year are compared to international prices for the corresponding marketing year, which is 1971. For that reason 1971 rather than 1970 is used as a base for the real effective exchange rate in computing the RPC for 1970.

6/ The RPC will take account of changes in the degree of exchange rate misalignment, but not in the absolute level. Only if there had been no misalignment in the base year, 1971, would the RPC accurately show the level of both direct and implicit taxation of agriculture. The average level of exchange rate distortion appears to have been relatively small in 1971 based on the ratio of official to parallel market exchange rates, which averaged 1.2 for countries with available data. Choosing a base year prior to the first oil price shock and subsequent volatility has obvious advantages. Still, exchange rates were seriously overvalued at that time in several countries, reflected in high ratios of parallel to official exchange rates: Ethiopia (1.17), Ghana (1.48), Kenya (1.35), Malawi (1.37), Sudan (1.77), Tanzania (1.62), Uganda (1.48), Zaire (1.45), and Zambia (1.49). In Nigeria the parallel market rate in 1971 was below the official rate.

Figure 3. NPCs and RPCs in CFA countries for major export crops



The actual levels of direct and implicit taxation (not just relative to a base year) of agricultural producers is difficult to assess short of elaborate and computationally difficult methods such as those recently developed by Krueger, Schiff, and Valdez, but as an approximation the RPC can be adjusted proportionally to the base year ratio of parallel market exchange rate to official exchange rate, and termed "adjusted RPC". Using this rough estimation procedure, the average adjusted RPC is compared for CFA-zone countries (where no significant parallel market distortion existed in 1971) and non-CFA countries (where the average ratio of parallel market to official exchange rate was 1.46 in 1971). The result (figure 4) suggests that: a) the degree of direct and implicit taxation of agriculture has been substantially higher in non-CFA countries throughout most of the past two decades, averaging 0.5 from 1970-1985, b) the adjusted RPC has fluctuated more in CFA countries, with averages ranging from 0.4 to 1.25, and c) for both sets of countries the level of direct and implicit taxation have moved in the direction of increased incentives to producers since 1984. 7/

The underlying causes of the large fluctuations in the RPC can be revealed by "decomposing" the annual change into its component effects. 8/ The three principal effects causing changes in the RPC are the nominal producer price, the real exchange rate, and the international price. 9/ In figure 5 each set of three bars will sum to the annual change in the overall RPC. Each bar represents the influence of each of the three major factors on the overall change in the RPC from the previous year; the sum of the three bars will reflect the change in the RPC from the previous year. For example, in 1972, the large negative effect of international price changes (rising international commodity prices) outweighs the smaller positive change due to nominal producer price changes and exchange rate changes, so that the net effect is a decline in the NPC between 1971 and 1972. By contrast, in 1986 the rise in nominal producer prices outweighed the small downward influence of changes in the exchange rate, resulting in a net effect raising the average RPC in 1986 over 1985.

Figure 5 shows that the decline in RPCs in the early 1970s was due to rising international prices unaccompanied by higher farm prices (which causes the RPC to fall), and smaller real exchange rate depreciations in 1973 and 1975. Producer prices were raised as indicated in the figure, by substantial amounts in 1973, 1975, and 1976, although only a portion of the international price rise was passed on to producers.

Beginning in 1980, large nominal devaluations in exchange rates drove the RPC down. The average RPC rose again in 1981 due to a drop in international prices (which were not fully passed on to producers), but in 1982 and 1983, the large devaluations lowered the average RPC substantially. Not until 1984, with the increased scope for raising nominal producer prices following devaluation, were the RPCs raised as a result of large increases in producer prices in 1984-87. In 1987 increased producer prices were offset by exchange rate devaluation (occurring in 1988), resulting in a small decline in the RPC.

7/ These results are relatively close to those estimated in Krueger, Valdez, Schiff for Cote d'Ivoire and Zambia. But for Ghana, they estimate a lower level of total taxation of cocoa during the 1975-79 period than estimated here.

8/ See Jaeger and Humphreys for the derivation.

9/ If only producer prices rise, the RPC will rise; if only international prices rise, the RPC will fall; if only the real exchange rate rises, the RPC will fall.

Figure 4. Adjusted RPCs for Africa's major export crops

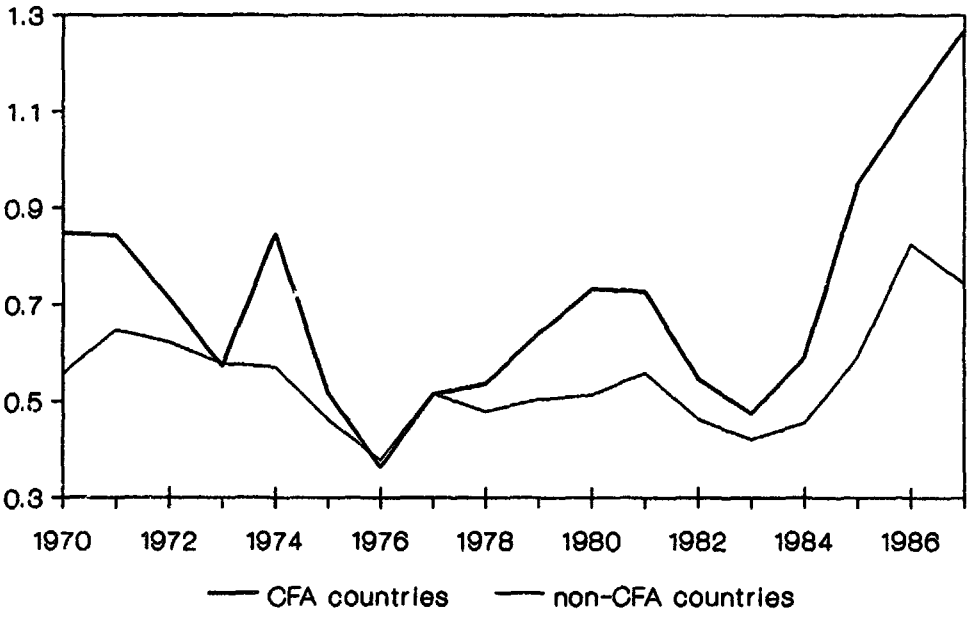
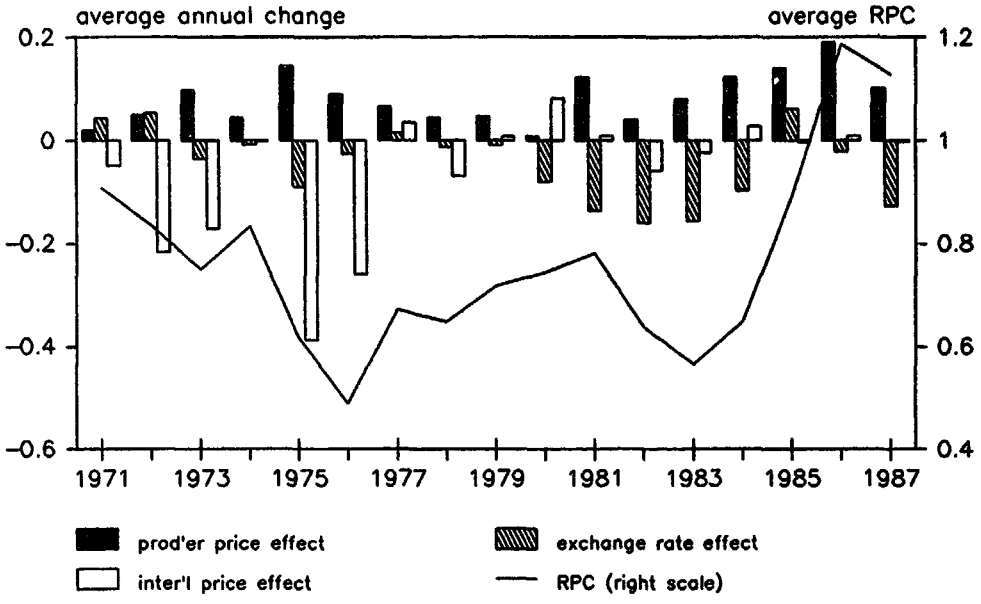


Figure 5. Decomposition of changes in RPCs for African export crops



As of 1986, the average RPC was greater than 1.0. This reflects several factors. First, several CFA countries recently began subsidizing producers (rather than taking the politically unpopular decision to lower producer prices). 10/ In addition, several other countries now have REERs which are "undervalued" relative to 1971, making their RPCs greater than 1.0. Taking account, however, of the exchange rate distortions at that time -- accomplished to a large extent by the "adjusted" RPC -- leaves the net effect as a taxation on agriculture (figure 4).

Real producer price trends. The net effect of both direct and indirect policy changes, as well as changes in international prices, are felt most directly by producer in terms the real prices received. Real producer prices for Africa's major export commodities have witnessed wide fluctuations since 1970 (figure 1). Throughout much of the 1970s these prices rose, on average, reflecting the rise in international commodity prices in the mid- to late-1970s, primarily for tropical beverages. The rise in producer prices for these commodities, however, was far less than the increase on international markets where real prices for primarily commodities more than doubled, whereas real producer prices rose, on average, less than 15 percent.

Between 1977 and 1982, the real prices received by farmers for these exports fell 25 percent resulting in part from a return to lower prices following the "boom" in tropical beverage prices in the mid 1970s, but also due to high domestic inflation and the reluctance of governments in Africa to respond by adjusting their exchange rates. Only after exchange rates were devalued, and real producer prices raised, did export performance begin to improve.

Export supply response

The response of agricultural production to changes in policies and incentives is a central issue with important implications for governments and donors. Views range widely on the responsiveness of agricultural production to price and this has given rise, to much debate (Chhibber, Binswanger, Cleaver 1988).

One source of these differing views is the distinction between the supply response of individual crops -- when factors of production can be quickly shifted from one crop to another -- and aggregate supply response which, in the long-run requires either additional resources to move from other sectors, higher investments, or technological change to bring about higher productivity. The fact that farmers respond strongly to changes in the relative prices of individual crops is well documented in empirical studies. This, however, tells us little about the aggregate response to changes in agricultural prices overall.

For African countries, relatively few supply response studies have tried to assess the relative importance of price, non-price factors, and exogenous shocks in explaining agricultural growth (Wheeler is a notable exception). And none has exploited the potential strength of using pooled cross-sectional time-series analysis to explain these relationships.

10/ This situation arose as the CFA franc, which is tied to the French franc, has appreciated making the US$ denominated international commodity prices appear much lower in local currency terms.

In addition, while much attention has been placed on the direct price incentives (generally producer prices), little work has included the indirect effects of macroeconomic policy distortions on agricultural growth, especially exports (Balassa, 1988, has used the real exchange rate as a proxy for incentives). Real exchange rates affect the competitiveness of agricultural exports by altering the relative prices of inputs and products. But inclusion of the real exchange rate - in addition to real prices - serves as a proxy for the costs and efficiency losses associated with trade and exchange restrictions that generally occur when exchange rates are highly overvalued.

The analysis presented here utilizes time-series data for the 1970-87 period and for 21 countries to estimate the response of agriculture to changes in real producer prices, macroeconomic policies (specifically the real exchange rate), the effect of weather, and major shocks in the form of "disasters" (including war, civil strife, famine, floods, or other disruptions). 11/

The model is as follows:

$$\text{AGRICULTURAL EXPORTS} = b_0 + b_1 \text{ REAL PRODUCER PRICE} + b_2 \text{ REAL EFFECTIVE EXCHANGE RATE} + b_3 \text{ WEATHER} + b_4 \text{ DISASTERS} + \epsilon$$

The analysis focuses on exports of agricultural commodities (cocoa, coffee, tea, etc.). For most of these commodities, nearly all production is exported so that exports are a reasonable approximation of production except in cases where domestic consumption is large relative to exports (as in the case of palm oil), or where smuggling results in a significant divergence of recorded exports from actual production. 12/ The food crop sector is, for the moment, left out of the analysis. To estimate similar supply equations for food crops would be problematic due to the lack of adequate producer price data. This results in part from the prevalence of officially announced prices for food crops which in many countries have little relation to what farmers actually receive. These official prices are often the only available price series. The interaction between food production and policy variables is addressed below.

Weather has an important impact on agricultural production in Africa, but quantifying that effect is problematic. Rainfall data is spotty and difficult to interpret correctly short of complex simulation models of soil moisture, daily rainfall, and evapotranspiration data, and different rainfall patterns will effect individual crops differently. An approximation for the general effect of weather on agriculture is derived here by estimating a regression trend line for cereal yields, and taking the

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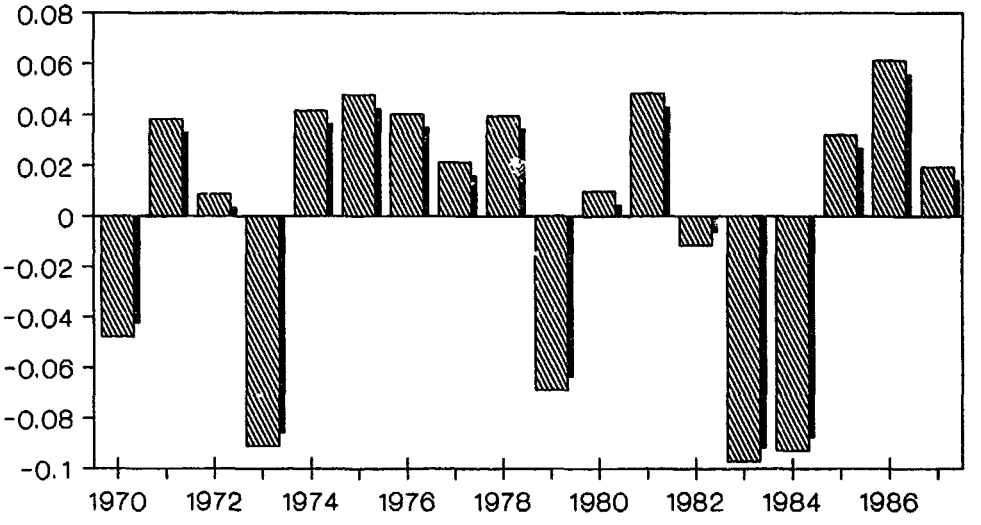
11/ Specification of variables and data sources can be found in Annex A.

12/ Several countries have been excluded from the analysis because of obvious "border effects" and smuggling. These include Benin and Zambia where dramatic swings in agricultural exports appear to have resulted from policy changes and border closings in neighboring countries. Also, Rwanda and Burundi are excluded due to apparent smuggling -- exports exceeded production by substantial amounts in several years. Ghana is often thought to have substantial smuggling but it is unclear that this accounts for a substantial share of total production.

Figure 6. The impact of weather on African agriculture
(deviations from trend in cereal yield)



residuals of that estimated trend to be a proxy for the effect of weather on agriculture in each year. 13/ The results are consistent with expectations overall (figure 6) and for individual countries and years where drought (Ghana and Senegal, 1983) or abundant harvests (Burkina 1985, 1986) are known to have occurred.

Major shocks such as war, civil strife, and natural disasters such as floods or cyclones have also had devastating effects on specific African countries. The potential impact of these phenomenon are taken into account in the model by including the percentage of the population affected by "disasters" as recorded in "Major Disasters Worldwide" (USAID).

The real effective exchange rate (REER) is included in the model (an increase in the REER indicates appreciation). As a measure of the competitiveness of agriculture it incorporates some of the incentives accounted for by the real producer price. However, REERs also provide a more general measure of distortions in product and factor markets, as well as serving as a proxy for the indirect effects of the exchange and trade controls that usually accompany overvaluation.

The results of the pooled cross-section time-series model 14/ are presented in table 1 (and Annex table 14). They include a number of variations of lagged and moving averages in the independent variables, and two subgroups of countries; a) those exporting primarily tree crops, and b) those exporting primarily annual crops. (Crop specific and country models are presented below.)

The weather variable is strongly significant in all of the equations. The coefficient ranges from 0.15 to 0.46 and is highest for the annual crop producers. The coefficients can be interpreted as a 10 percent drop from trend for cereal yields associated with a 1.5 to 4.6 percent decline in exports. The "disasters" variable has the expected sign and is significant in most cases.

The estimated price elasticities of export supply for all countries range from 0.1 to 0.3, and the elasticities with respect to REER range from -0.1 to -.25. For countries exporting primarily tree crops (where longer lagged responses are expected) the REER is the most consistent explanatory variable with elasticities ranging from -0.14 to -0.25; the price elasticities for tree crop exporters are only significant when the REER is excluded (with an elasticity of 0.115) or in one case significant with the wrong sign (an elasticity of -0.06).

Higher price elasticities can be expected from countries exporting annual crops such as tobacco and cotton, as farmers are more able to respond quickly to changes in relative price incentives by

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13/ Cereals are the most susceptible crop to moisture stress, and for most countries variation in average yields of cereals will result primarily from variations in weather. While exported crops may respond differently to specific weather patterns, the deviations from trend can be expected to be of the same sign. Year to year variations in cereal yields could arise due to fluctuations in fertilizer availability or other policy related factors, but with few exceptions fertilizer is not widely used on cereals and other factors are not likely to dominate the effects of rainfall.

14/ The pooling of cross-section time-series data can be accomplished several ways depending on the characteristics of the data. Since these data are time-wise autoregressive and cross-sectionally correlated, a three-stage procedure is required to produce consistent, unbiased estimates following Kmenta (pp. 512-514), and using the SAS Park estimation procedure from SAS SUGI Supplemental software.

altering their cropping pattern. The estimated elasticities for these countries are indeed much higher, ranging from 0.56 to 0.94, suggesting highly responsive adjustments to changes in real prices. For this subgroup, however, the real exchange rate variable is only weakly significant in one case, and has the wrong sign. 15/

Overall, these results indicate that agriculture is only moderately responsive to changes in pricing and exchange rate policies in the short-term. Producers of annual crops such as cotton or tobacco respond quickly and with an elasticity near 1.0. The estimated elasticities for tree crop exporters are low, reflecting the limitations on quick adjustments for these crops. Even a three to five year lagged price variable will be inadequate for estimating long-run supply responses in these cases, both because adjustments can take longer than that, and because farmers respond to changes in expected prices, not short-term booms or busts that will not be expected to persist. Shorter-run responses can come only from rehabilitating existing plantations.

These results indicate that for tree crops the indirect relationship with respect to the exchange rate is stronger than the relationship with producer prices. This might reflect indirect effects caused by the constraints and distorting trade and exchange controls that commonly occur when exchange rates are overvalued. Or the estimates may be biased upward as a result of the omission of unrecorded production and smuggled exports that tend to occur when exchange rates are seriously overvalued.

Crop specific models of agricultural exports were estimated for several major export commodities (table 2). The results are similar to those in table 1. The short-run responsiveness to price is about 0.23 for coffee, about the same for cocoa but not significant. For cotton, an annual crop, the responsiveness of exports to price is much higher with an elasticity of 0.67 both for the producer price and the real exchange rate. For tea the results were not significant, apparently due to the small sample.

15/ The significance of the overall equations has been tested using a covariance model and is highly significant at the 99% level. The three-stage pooled estimation procedure does not permit computation of F-values.

Table 1. Regression Equation for Agricultural Supply in Sub-Saharan Africa.

	All countries		Tree Crop Exporters		Annual Crop Exporters	
Model	(1)	(2)	(3)	(4)	(5)	(6)
Producer Price						
Moving average (t and t-1)	0.202	0.240	0.017	0.115	0.940	0.920
	(12.97)	(204.2)	(1.13)	(5.04)	(6.26)	(6.08)
Real effective exchange rate						
Moving average (t and t-1)	-0.104		-0.253		0.330	
	(-4.15)		(-13.86)		(2.09)	
Disasters variable	-0.0006	-0.0010	-0.0003	-0.0016	0.0013	0.0009
	(-2.15)	(-49.7)	(-0.43)	(-1.69)	(0.92)	(0.67)
Weather variable	0.373	0.382	0.153	0.219	0.440	0.435
	(21.64)	(299)	(5.18)	(5.54)	(6.29)	(5.7)
Intercept	4.12	3.44	5.62	4.01	-1.29	0.33
	(26.87)	(625)	(41.5)	(36.8)	(-1.46)	(0.47)
Degrees of freedom	331	332	219	220	91	92

Note: Exports, producer prices, exchange rate, and the weather variable have been expressed in logarithms. Their coefficianst may be interpreted as elasticities.

Figure in parentheses are t-values.

Table 2. Regression Equations for Agricultural Supply in Sub-Saharan Africa: Crop models

	Dependant variable: total agricultural exports			
	Cocoa	Coffee	Cotton	Tea
Producer price a/	0.22*	0.23**	0.67**	-0.04
	(1.75)	(8.07)	(4.02)	(-0.50)
Real effective exchange rate a/	-0.35**	0.055*	-0.68**	0.126
	(-3.91)	(1.94)	(-5.04)	(0.65)
Disasters variable	-0.0067	-0.0037**	0.0026	-0.0192**
	(-1.49)	(-2.86)	(1.64)	(-3.14)
Weather variable	-0.20	-0.163**	0.226*	0.033
	(-1.65)	(-2.82)	(2.4)	(0.21)
Intercept	5.16**	3.30**	4.43**	4.24**
	(5.8)	(15.2)	(3.9)	(4.02)
Degrees of freedom	107	219	171	59
Countries	7	14	11	4

Notes: Exports, producer price, exchange rate, and the rainfall variable have been expressed in logarithms. Their coefficiants may be interpreted as elasticities.

Years refer to split crop years (e.g. 1980/81). Since marketing occurs in the second of the two calandar years, export data for the 1981 calandar year correspond to prices, rainfall, etc. for 1980.

The pooled cross-section time series procedure was used.

Figures in parentheses are t-values. Significance levels are * (95%) and ** (99%).

a/ Two year moving average (t and t-1)

Table 3. Regression Equations for Agricultural Supply in Sub-Saharan Africa: Country models.

	Dependant variable : total agricultural exports								
	Ethiopia	Ghana	Kenya	Malawi	Nigeria	Senegal	Tanzania	Togo	Zimbabwe
Producer Price a/	-0.84*	1.17**	-0.48	-0.07	0.22	1.52	0.42	2.1**	0.86*
	(-2.3)	(3.8)	(-2.0)	(-0.14)	(0.56)	(1.83)	(0.58)	(3.3)	(2.48)
Real effective exchange rate a/	-1.64*	0.32	0.35	2.13*	-1.03**	1.65	-1.07*	0.24	0.29
	(-2.55)	(1.6)	(0.27)	(2.99)	(-4.4)	(0.22)	(-2.6)	(0.29)	(1.75)
Disasters variable	-0.0016	-0.019*	-0.046	-0.005	4.18	0.0008	-0.007	0.068*	-9.03
	(-0.15)	(-2.68)	(-0.75)	(-0.12)	(1.52)	(0.126)	(-0.24)	(2.51)	(-0.66)
Weather variable	-0.029	-0.40	0.96*	-0.023	-0.40	1.36	-0.65	-0.146	0.56**
	(-0.069)	(1.84)	(2.23)	(-0.049)	(-0.66)	(2.02)	(-0.66)	(-0.38)	(4.08)
Intercept	15.9	-2.15	5.2	-4.90	8.16**	-10.07	7.54	-6.17	-0.73
	(3.79)	(-2.17)	(0.80)	(-3.78)	(3.1)	(-1.45)	(1.62)	(-1.01)	(-.41)
Degree of freedom	12	12	12	12	12	12	12	12	12
R square	0.66	0.85	0.72	0.85	0.81	0.64	0.75	0.78	0.62

Note: Exports, producer price, exchange rate, and the rainfall variable have been expressed in logarithms. Their coefficiants may be interpreted as elasticities.

Years refer to split crop years (e.g. 1980/81). Since marketing occurs in the second of the two calendar years, export data for the 1981 calendar year correspond to prices, rainfall, etc. for 1980.

* indicates statistically significant at the 95% level.

** indicates statistically significant at the 99% level.

a/ Two-year moving average.

Country-specific models were also estimated (table 3). There are striking differences between these models and those estimated pooling cross-section and time-series data. The estimated elasticities differ widely between countries. For a number of countries the elasticity with respect to price, or with respect to the exchange rate, is quite high (Ghana, Nigeria, Tanzania, Togo), often around 1.0, and in one case exceeding 2.0. 16/ These wide differences in estimated elasticities may reflect the small number of observations or other data problems, or the diversity among African countries that gives rise to real differences in the responsiveness of farmers to price incentives (see Section IV below).

Estimates of aggregate supply response in the literature range from 0.1 to 0.5 (Binswanger, Bond, Chhibber). But procedures used to estimate long-run elasticities such as the Nerlove techniques (which uses lagged dependent variables to derive intertemporal adjustment coefficients) provide estimates that are generally believed to be too low and not good estimates of the response of crops to a permanent change in the price regime of agriculture (Binswanger). In addition, there are problems with the interpretation of distributed lag models, and simultaneity problems that can arise in the data.

In summary, current statistical methods appear inadequate to estimate reliably long-run supply response. Since the year-to-year price fluctuations in the data normally reflect short-lived commodity booms rather than permanent changes from a low price to a high price regimen, any estimate based on these data will reflect short-run adjustments rather than long-run responses to permanent changes in price levels (Binswanger). Farmers will respond to expected prices, which are generally not observable. Given the preponderance of tree crop exports in Africa, it is not surprising that these short-run elasticities are low. The long-run aggregate supply response will include the effect of reallocation of productive resources, labor and capital, among sectors in the economy overall. It may also include changes in government expenditures and public capital investments for infrastructure, research, human capital and institutional support which may be more forthcoming in the context of higher incentives.

III. THE IMPACT OF POLICY ON THE FOOD CROP SECTOR

Analysis of the food crop sector in African countries is more problematic than export crops due to poor quality and limited availability of the production and price data -- in addition to other differences. Many African countries set official food prices, and thus only the officially announced price figures are available. For a majority African countries, however, official prices are not effectively enforced, and most producers receive a market determined price for their food sales.

16/ In three cases the estimated price elasticity is negative -- Ethiopia, Kenya, and Malawi -- although only significant for Ethiopia. These three countries differ from the others in that producer prices are determined ex post at international auctions. Farmers will not respond to current or lagged prices unless they reflect changes in expected price. Because prices received by farmers in these countries fluctuate widely from year to year, very high prices paid in one year may do little to change their price expectations unless there is some perceived change in the long-term price level for their products in international markets. Hence, the lack of a significant relationship is not surprising, although in the case of Ethiopia the negative sign is puzzling, and may reflect complications related to coffee quotas, or the influence of Ethiopian exports on price.

Cross-price effects between export prices and food

The elasticities estimated above for export crops will overstate the responsiveness of aggregate agriculture if higher exports are offset by a fall in food production (in the same way single crop estimations tend to overstate aggregate supply response). If the export response has come from a shift of resources away from food crops and toward export crops, then the net increase in total agricultural output will be lower.

Direct estimation of food crop models in the above analysis is not possible due to a lack of price data. However, by replacing the dependent variable in the above formulation with food production, it is possible to test the hypothesis that export incentives lead to offsetting effects in food production. Similarly, the relationship between food production and the real exchange rate can be estimated.

The results of these models are shown in table 4. Three different dependent variables have been used; total agricultural production, total food production, and staple food production. The estimated elasticities indicate that food production responds positively to changes in export crop producer prices. Total agricultural production, total food production and staple food production respond positively to changes in export crop prices and real exchange rates. The result with respect to the exchange rate is expected, as both tradable food crops and export crops are affected in similar ways by exchange rate distortions. 17/

There is no evidence of offsetting changes between export and food crops. Even for countries where the principal exported crops are annuals with high supply elasticities of about 0.9, the cross-price elasticities on total food or staple foods provide no statistically significant evidence of a trade-off. Indeed, the only statistically significant result is for a positive cross-price elasticity for staple foods.

There are several possible explanations for the positive cross-price effect of export crop price on food production: a) food and export crops may be complements in production (fertilizer benefits both crops when grown together or in succession), b) returns on export production permit higher input use or investment in food crop production, or c) a third, omitted, factor -- such as government policy that generally favors agriculture -- affects both export and food crops in the same way. The results presented here are consistent with other empirical findings that have found a positive correlation between expansion of export crops and growth in food production. One such study concluded that "conditions favoring agricultural growth, including appropriate economic policies, encourage both cash crop and basic staple food crop production" (von Braun and Kennedy).

17/ To the extent that the REER may be a proxy for agricultural terms of trade overall (for both export and food crop incentives) the aggregate responsiveness implied here for total agricultural production is an elasticity of 0.045, which is very close to the 0.05 estimate for aggregate output in India by Bapna (reported in Binswanger).

Table 4. Regression equations for cross-price effect on food production

Dependent variable	Independent variables a/	
	Export crop producer price (2 year moving avg.)	REER (2 year moving avg.)
All Countries		
Total agricultural production	0.033**	-0.045**
Food production	0.046**	-0.013**
Staple foods	0.065**	-0.018**
Annual crop producing countries		
Total agricultural production	0.028	-0.110
Food production	-0.016	0.085
Staple foods	0.183*	0.401

* Statistically significant at the 95 percent level.
** Statistically significant at the 99 percent level.
Note: "staple foods" is an aggregate of total production of cereals, roots and tubers, pulses, oil crops, bananas, and plantains in grain equivalent units converted on the basis of their relative caloric content.
a/ Full model is same as model 1, table 1.

The importance of food production and policy goes beyond its relationship with export agriculture. Food policy in Africa differs from export agricultural policy in many respects. For this reason, and due to the more limiting data, food policy and productivity are assessed separately below.

Food Policy

In only about half the 35 African countries in the sample do governments intervene substantially in the marketing and pricing of food crops (eleven fewer than in the 1970s). In some of those that do, or did, intervene, government intervention was restricted to marketing of imported foods, mainly rice or wheat to urban consumers, having indirect effects on domestic producers.

The effectiveness of government food marketing and pricing policies is difficult to assess precisely given the paucity of information on the size and scope of parallel markets in many African countries. Among those countries that do intervene to set prices and control marketing, however, evidence suggests that few do it effectively. Where details are available significant parallel markets appear to exist. Zambia appears to be an exception, where the very high subsidy to official marketing has prevented much private trade from developing (Harvey), although there are substantial cross-border food movements to neighboring countries. In Zimbabwe, Kenya, and Botswana, controls are at least partially successful, but parallel markets exist. Nevertheless, accounts differ on the importance of parallel markets in many countries. For example, in Mali prior to liberalization, one account reports that the existence of parallel markets implied free price

formation (Lecaillon and Morrisson). And in Ethiopia government confiscation and restrictions on transportation of food affect only certain regions. 18/

Where data are available comparisons of food crop producer prices to border prices, or NPCs, show wide swings from year to year and across countries (Annex D table 11). In many countries producer prices are higher than border prices (the NPCs are greater than 1.0) because of protection from imports -- due either to government policies or high transport costs which create natural barriers. While most of these countries import food, in good years they may also export food to neighboring countries. In some countries the net effect on producer prices is an implicit subsidy due to restrictive import quotas (Nigeria, Ghana) or rationing of foreign exchange.

The high transport costs (annex D table 7) and year-to-year swings in domestic production makes establishing the level of protection difficult, since the food price may fluctuate within a wide range between export and import parity prices. As long as the price remains within that band, the influence of border prices on domestic market prices is ambiguous, and it is unclear whether the producer price should be compared to export or import parity at all for assessing distortions. In situations like this the NPC provides little useful information. 19/

Real food price trends

Real producer prices for food crops have fluctuated much less than for export crops, except for a rise in prices following the world food shortage of 1974 (figures 7 and 8), aside from which there is no perceived trend on average. The ratio of export to food crop prices, however, has changed significantly over the period, falling from 1970 to 1984 (except during the commodity boom in 1975-79). Overall the price ratio declined by about 20 percent over the period, Since 1984, however, the trend has seen a large reversal, with export crops regaining their 1970 parity in just two years, followed by a small decline in 1986.

These patterns have been due to a combination of exchange rate, trade, and pricing policies. Exchange rate policies have discriminated against tradable foods, driving down the real prices of exported and import competing commodities. In some cases, however, foreign exchange constraints and import controls limit imports and thus may give rise to somewhat higher food prices. The net effect of these policies is thus ambiguous. To the extent that domestically produced foods are nontraded crops (cassava and yams) that are imperfect substitutes, the appreciation of the real exchange rate may raise their price relative to traded food and export crops.

Trends in consumer food prices show that relative to border prices at official exchange rates, domestically produced food crops became more expensive during the 1970s (Annex D table 12)

18/ Even with more detailed information on the parallel markets in food crops, it would still be difficult to assess the impact of government efforts to restrict private trade on producers incentives. Enforcement is rare, but where it does occur, and where transporters are restricted by law from carrying food crops, low official prices will have some disincentive effects.

19/ With high transport costs from producing region to border, an NPC (computed as an import competing commodity) less than one has an inconclusive interpretation of the effect of policy. It may simply be that the price has not fallen sufficiently low for the commodity to become an exported good.

Figure 7. Real producer prices for major crops in Sub-Saharan Africa

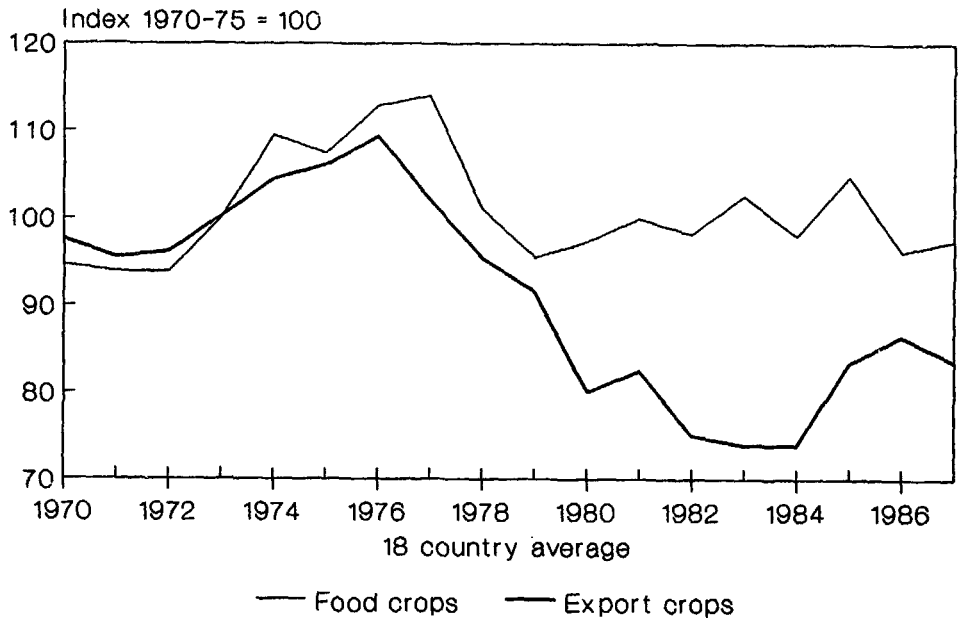
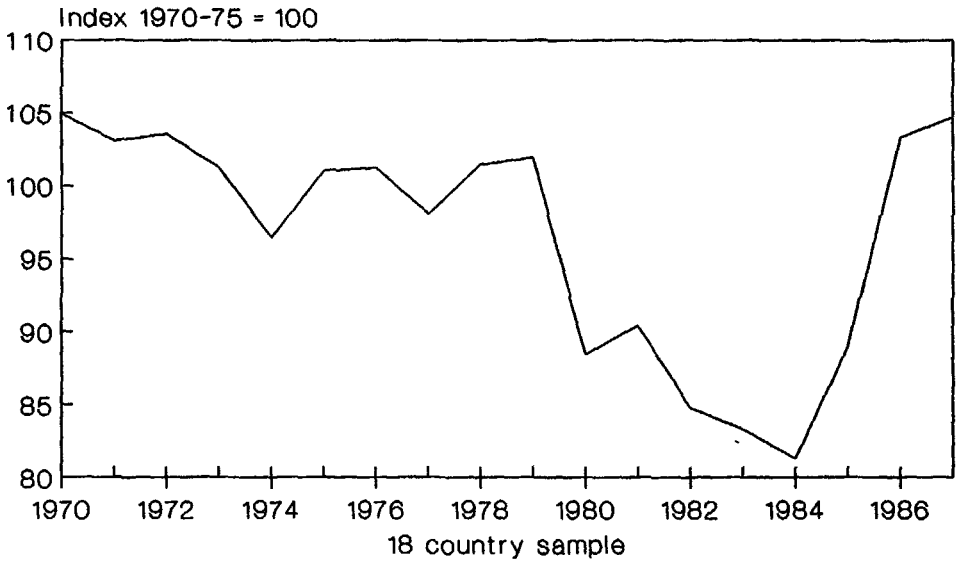


Figure 8. Ratio of export/food producer prices in Sub-Saharan Africa



relative to imported rice and wheat. Cheaper imports resulted from lower international prices and overvalued exchange rates. Trade restrictions and imperfect substitution between foods appear to have kept prices of domestically produced foods somewhat higher.

When traded foods are distinguished from nontraded roots and tubers, the trends in the 1980s illustrate the effects of exchange rate distortions and changes in domestic pricing policies (table 5). As distortions in real exchange rates have declined -- in addition to food market liberalization in some countries -- prices of traded foods have risen, while nontraded food prices have fallen. This should have the effect of shifting demand toward domestically produced foods and away from imports (discussed in more detail below).

Table 5. Comparison of real consumer food prices in Africa

	Indexes		
	1977-79	1980-82	1985-87
Traded food crops (n=14)	100	103	112
Nontraded food crops (n=9)	100	96	89

Overall, food prices have been affected less than export crops by government policies (with a few notable exceptions where pricing and marketing are effectively enforced). This has been because: a) in many countries direct policy interventions have been ineffective, and b) exchange rate policies have effected domestic food prices less in part because of trade restrictions that have limited imports of cheap food.

Food imports, and slow food production growth

Food production in Africa has grown more slowly than population since 1970 20/ leading many observers to conclude that this "deterioration" is evidence of the general failure of African agricultural:

"Many African states have slowly lost the capacity to feed their people" (Eicher 1986).

"[Africa's] poor performance has led to a remarkable increase in food imports.... The availability of food imports has greatly offset the impact of poor agriculture performance on food security, but not enough in aggregate to ensure an adequate diet to the average African (Serageldin)."

20/ Per capita food production has fallen at a rate of about 2 percent per year since 1970 -- the only region in the world with declining per capita food production. At the same time Africa has become a net importer of food, doubling food imports during the late-1970s while food exports stagnated. Compounding these overall trends are the periodic and transitory shortages and food insecurity that affect large numbers of people in Ethiopia, Sudan, Mozambique, and the Sahelian countries most prone to food shortages over the past 15 years due to drought or war or both.

Consumption of food, however, has not declined. Since the 1960s average caloric consumption has been relatively stable or rising slightly in Africa. There has, however, been a shift in the composition of consumption toward an higher share of imported foods, especially rice and wheat.

But while imports have clearly been substituted for domestic production, this leaves open the question of the casual direction of the shift between imports and domestic supply. Has deterioration of productive capacity forced Africans to import more food? Or has a shift in demand in favor of imports resulted in declining demand for domestically grown food (and thus resulting in slower growth in production)?

Demand for food imports may rise for several reasons independent of the adequacy of domestic supplies. Imported foods (generally rice and wheat) are imperfect substitutes for other, domestically-grown staples (millet, sorghum, maize, cassava, and yams). Imported rice and wheat tend to be preferred foods in Africa for reasons of tastes, social status, and ease of preparation, and they tend to exhibit a high income elasticity of demand (Delgado). Preference for imported foods is most often manifest among urban populations in Africa.

As a result, changes in import demand should result from changes in the following variables: a) the relative price of imported foods to domestic foods, b) income, especially foreign exchange earnings, and c) demographic changes such as urbanization which would increase the share and numbers of the population with a high propensity to consume imported foods. Before testing these hypotheses econometrically, each is elaborated further below.

The relative price of imported to domestic foods will be affected by changes in international prices, exchange rate policies, changes in barriers to trade such as import restrictions, and official domestic pricing policies. Exchange rate policies will alter the price of domestic food relative to imported foods to the extent that domestic food prices are not fully affected by international market prices. High transportation costs, other barriers to trade, or the lack of international markets for staples such as yams, will make these products essentially nontradable goods and therefore their prices will rise relative to imported food prices as currencies become overvalued. Additionally, when currencies are overvalued governments generally must ration foreign exchange and place restrictions on imports in order to avoid exhausting reserves. These restrictions may lead to inefficiencies in domestic food production and marketing to the extent that it is dependent on imported inputs such as fertilizer, fuel, or farm machinery. If, however, import restrictions involve food imports themselves (eg. the banning of food imports in Nigeria) then the net effect of exchange rate distortions could be to reduce food imports, but only a few countries have implemented effective import restrictions. Domestic pricing policies which discriminate against producers will limit the extent to which domestic production is stimulated by growth in demand, giving rise to a policy-induced food gap. In addition, consumer oriented "cheap food" policies will, to the extent that they apply to imported foods such as rice and wheat, further shift demand toward imports and away from domestically produced food.

Higher incomes will raise consumption, including imports. A number of studies have observed a strong positive relationship between high agricultural growth and rising food imports in developing countries generally. These studies cite the income effect of strong agricultural growth as leading to increased demand for imported foods (Bautista). While few African countries fit the category of having strong agricultural growth, a number have seen periods of rising incomes from other sources over an extended length of time (eg. oil exporters). In particular, a country's import capacity, or the total of export earnings, foreign investment, borrowing, and grant aid, will affect demand for imported foods overall.

Growth in urban population is likely to lead to higher food imports if the propensity to

consume imported food is higher among urban dwellers. This appears to be the case for reasons of higher urban incomes, status, and easier and quicker time of preparation (Delgado). Urban growth due to rural-to-urban migration is influenced by government policy. Macroeconomic policies, pricing policies, and the provision of social services all contribute to shifting the rural/urban terms of trade in favor of urban dwellers and thereby making migration from rural to urban areas more attractive. This is likely to increase food imports due to higher demand, but also there may be a supply-side effect if urban migration depletes the rural labor force leading to a decline in domestic production.

Aggregate pattern of food imports. The aggregate patterns of Africa's food imports are presented in figure 9. Food imports varied little between 1970 and 1976, ranging between 7-8 million metric tons. Over the next four years, however, food imports doubled to more than 14 million tons, and remained at these high levels until 1986 when they began to fall gradually. Surprisingly, the period during which this sharp increase occurred was a very favorable period in terms of the weather pattern and its effect on cereal yields (except in 1979). And food aid accounts for less than 10 percent of the increase, although food aid shipments continued to grow in the 1980s raising its share in the total considerably, especially following the 1982 and 1983 droughts (imports net of food aid fell to under 10 million tons by the mid-1980s).

On closer examination of these data, however, one notes that the doubling of Africa's food imports during this period resulted in large part from events in one country, Nigeria (figure 9). Indeed, seventy percent of the increase in Africa's food imports -- or about 5 million tons -- is accounted for by changes in Nigeria's imports during that country's oil boom. Given the events in Nigeria during that period, a number of contributing factors suggest themselves. First, oil revenues resulted in a sharp rise in the nation's income and capacity to import. Annual import capacity, defined as export earnings, net borrowing, direct foreign investment, and aid, nearly doubled, increasing by $14 billion during the same period (figure 10). Second, the disruptive economic impact and "dutch disease" effects of the oil boom on macroeconomic variables resulted in rising prices and wages, an increasingly overvalued currency, a shift of labor from traditional agriculture to industrial and service sectors, and rural-to-urban migration. All of these factors contributed to both rising demand for food imports and a decline in domestic production relative to population.

The changes which were brought about were of such magnitude that for three of Nigeria's four major agricultural exports -- peanuts, cotton, and palm oil -- exports ceased, and in all three cases Nigeria became a net importer of these commodities by the 1980s.

These very dramatic changes that occurred in Nigeria -- Africa's largest economy -- are likely to be indicative of phenomenon at work in other countries, albeit to a lesser degree. How generalizable these phenomenon are in explaining Africa's food crisis, is the question to which we now turn.

Empirical mode. To test the significance and relative importance of these variables in explaining changes in Africa's food imports an econometric model is estimated for a sample of 31 countries with data from 1971 to 1987. For a sample with these characteristics, pooled cross-section, time-series analysis was chosed as potentially the most powerful method. Food imports are regressed on

Figure 9. Africa's food imports

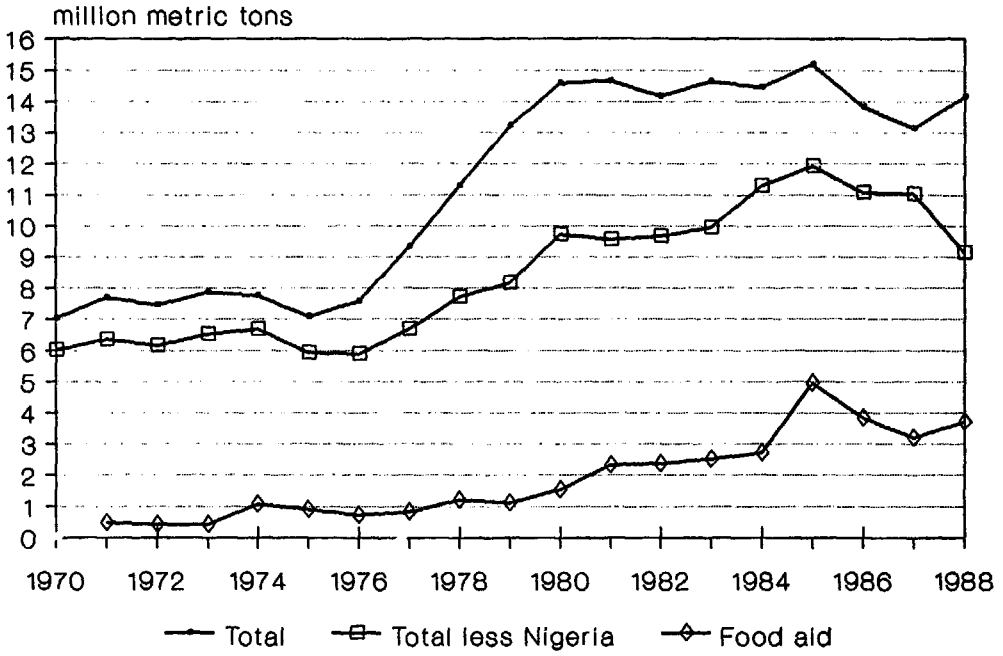
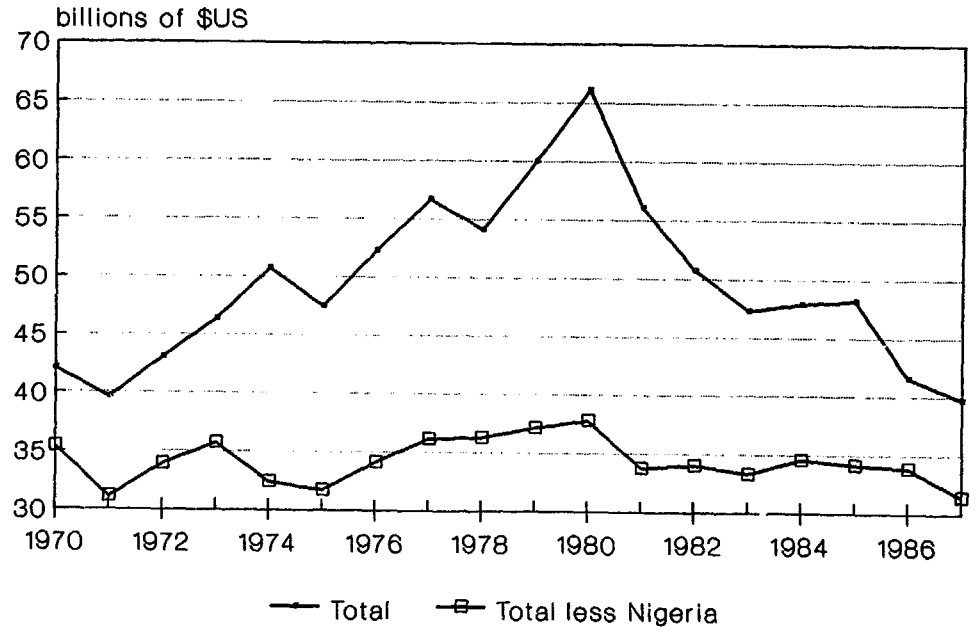


Figure 10. Africa's import capacity
(exports, borrowing, aid, investment)



urban population, the real effective exchange rate, import capacity, a "weather" variable, and trend in the following way: 21/

$$\text{FOOD IMPORTS} = b_0 + b_1\text{URBAN POPULATION} + b_2\text{REER} + b_3\text{IMPORT CAPACITY} + B_4\text{WEATHER} + B_5\text{TREND} + \epsilon$$

Food imports are total volume figures, net of food aid. 22/ URBAN POPULATION is an index based on the total numbers of urban residents. The REER is the real effective exchange rate as defined by the IMF. It is an index which measures the evolution of a country's prices relative to those of its trading partners, adjustment for nominal exchange rate changes. The IMPORT CAPACITY is the sum of export earnings, net borrowing, foreign investment, and grant aid deflated by Africa's import price index.

The two variables, WEATHER and TREND, reflect the hypotheses for a supply side explanation of variation in food imports, which are unrelated to prices, policy variables, or urbanization. A secularly increasing TREND in food imports would support the hypothesis that there has been a deterioration in Africa's productive capacity. And poor WEATHER (rainfall as well as tornados or floods) that affect domestic production will necessitate higher imports. Clear cases of weather-related causes occurred during the period considered, including frequent severe drought between 1973 and 1984. Since 1984 Africa appears to have seen more normal rainfall patterns on average. The WEATHER variable is a proxy derived from annual data on cereal yields per hectare for each country. It is estimated as the percentage deviation from trend in cereal yields over the period.

Empirical results. Table 6 presents the results of the regression described above. All estimates of the coefficients in the equation agree in sign with *a priori* expectations. All the explanatory variables are statistically significant at the 1 percent level, except for the REER which is significant at the 5 percent level.

The estimated coefficient and significance for urban population indicates that urban growth is strongly associated with increased food imports. This variable held the strongest statistical relationship in terms of the addition to the r-squared when the variable was added to the equation (using ordinary least squares estimation). The addition to the r-squared was 0.237, as compared to 0.07 for import capacity, 0.05 for the weather variable, and 0.0017 for the trend.

It should be recognized with respect to the urban population variable that the estimated relationship may conceal an underlying, omitted variable which is correlated to both. In particular, government policies which alter the rural-urban terms of trade in favor of urban consumers -- such as cheap food policies -- will simultaneously encourage urban consumption of the subsidized foods (generally these programs include imported rice and wheat) and urban migration, which will likewise

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21/ Data are from World Bank and FAO. Data for food imports, urban population, and import capacity are normalized as indexes to abstract from country size (1970-87 average = 100).

22/ Food aid is excluded from food imports because it is a component of grant aid and therefore it would create an endogeneity problem if included in the right-hand-side variable, "import capacity." Also, while emergency food aid shipments respond to domestic shortfalls in production, increasingly in the 1980s the relationship between "structural food aid" shipments and patterns of demand and supply in Africa were not obvious.

lead to rising food consumption and imports. Indeed, Zambia, where cheap food policies have been in place for 40 years, has the most urbanized population in Africa.

Table 6. Regression equation for Sub-Saharan Africa's food imports

	Dependent variable: food imports	
variable	Coefficient	t-value
Constant	13.3	(3.3)**
Urban population	0.29	(10.7)**
Real exchange rate	0.06	(2.1)*
Import capacity	0.40	(21.0)**
Weather	-59.3	(-23.7)**
Trend	1.09	(7.4)**
Degree of freedom = 487		

Source: World Bank and FAO.
* indicates significance at the 95 percent level.
** indicates significance at the 99 percent level.
Note: pooled cross-section time-series GLS method was used.

An additional ambiguity in this result is the extent to which urbanization has affected domestic food production as a result of a reduced agricultural labor force. Outmigration of agricultural labor may result in slower growth in production relative to overall population growth. The upward pressure of prices for domestic foods that might result would further shift demand toward imports. If, however, producer food prices are controlled, or if cheap food imports or food aid keep producer prices low, the price signals necessary to stimulate growth in domestic food production for an increasingly urban population may not ensue. To the extent that this is occurring, some of the increase in food imports may be seen as a supply problem, but one whose origins lie in rural to urban migration and the policies which have encouraged it.

The estimated coefficient for the real exchange rate implies that exchange rate policies have contributed to the growth in Africa's food imports. There are several ways in which overvalued exchange rate will contribute to food imports. The most direct way is through its effect on the relative prices of imported versus domestically produced foods, many of which are nontraded or have significant natural barriers between domestic and international prices. Thus when exchange rates become overvalued imported food prices will fall relative to domestic prices leading to a shift in consumption toward imported food. In addition, overvalued currencies are usually accompanied by trade and exchange restrictions (in order to stem the excess demand for foreign exchange reserves). This may have the added effect of reducing productivity in domestic food production in cases where food production relies on imports such as fertilizer, fuel and farm machinery. In some cases, howeve , the accompanying import restrictions may also apply to some imported foods. If effective this would have the opposite effect of reducing food imports. The existence of such contradictory effects may explain the lower significance level for this variable.

The coefficient for import capacity is positive and significant indicating an income effect, or that changes in aggregate purchasing power are positively associated with changes in food imports. As described above the very large increases in Nigeria's import capacity coincided with the doubling of

Africa's food imports, 70 percent of which went to Nigeria. Many other countries were affected to a lesser degree by commodity booms in the late 1970s for cocoa, coffee, and phosphates, as well as the four other countries exporting oil. And growth in aid and borrowing of recycled OPEC revenues raised the capacity to import of many African countries during the late 1970s. By contrast, the debt crisis in the 1980s reduced substantially the import capacity of many of these countries.

The weather variable (lagged one year) is significant and has the expected sign: cereal yields below trend in year t-1 are associated with increased food imports in year t. Despite the exclusion of food aid from the dependent variable, commercial food imports are responsive to shortfalls in domestic production caused by weather-related factors. Deteriorating weather, however, does not explain the secular rise in food imports since this variable is in terms of residuals, or deviations from trend, and the trend for most African countries showed increasing yields for cereals over the period

The trend variable is significant and has the expected sign. The value of the coefficient is small, however, suggesting a rise in food imports of only about 1 percent per year. 23/ In addition, the significance of the variable in terms of its addition to the r-squared was very small as reported above. Nonetheless, a likely explanation for the significance of a slight trend is the decline in international rice and wheat prices over the period, which would be expected to raise imports. Wheat prices have fallen in real terms by a third, and rice prices by half, between 1970 and 1986. Thus, in addition to the impact of exchange rate policies on the relative prices of domestic versus imported foods, border prices for imported foods have fallen over the period, encouraging additional substitution toward imports in consumption.

Overall, the regression results provide important evidence that Africa's food import growth has been, in part, demand driven rather than resulting from failed domestic production -- although urban migration and trade and exchange restrictions are likely to have had an effect on supply as well. Demand has been influenced by government policies, urbanization, and import capacity. Urbanization is the strongest explanatory factor. But government policies, to the extent they account for differences in rates of urban migration, under the strong relationship attributed to urbanization. Evidence of that link is presented below.

Policy and rural-urban migration

The link between policies and the rate of rural-urban migration has only been imprecisely identified thus far. Governments affect the rate of rural-urban migration through macroeconomic and pricing policies that alter the domestic, or rural-urban terms of trade. These include exchange rate policies and cheap food policies, both of which generally discriminate against the rural sector. In addition, government programs such as the provision of schools, health service, and water supplies, may favor urban locations thereby encouraging migration. But determining the extent of these influences is problematic due to poor census data and the gradual nature of these demographic shifts. Anecdotal evidence provides some support to the importance of these policies on urbanization. For example, Zambia, which has had highly subsidized cheap food policies for more than 40 years, has the highest share of urban population in Sub-Saharan Africa.

23/ Although not expressed precisely as a growth rate, the dependent variable is an index with an average value of 100 for the entire period. Thus a coefficient of 1 can be taken as approximating a 1 percent per year trend.

Only with large changes in policy variables would one expect observable shifts in the rate (or even the direction) or rural-urban migration. Some observers contend that in several countries such as Ghana, Nigeria, and Tanzania, where profound policy changes altered the domestic terms of trade in favor of the rural sector, urban dwellers are returning to the farm. Because of poor demographic data, however, these patterns have been difficult to substantiate.

In the case of Ghana, however, recent survey data from the World Bank's Ghana Living Standards Measurement Survey offers an opportunity to authenticate the pattern more concretely. In a survey of over 8,000 individuals in Ghana, information on current and prior employment was collected. From this data, respondents were broken down by principal occupation into agricultural and non-agricultural, and similarly for previous occupation. For those who changed occupations between mid-1984 and 1988 -- the time of the survey -- prior and current occupation was tabulated as shown in table 7.

Table 7. Rural-urban migration in Ghana since structural adjustment
(principal occupation 1984-88, in percent)

	Current Occupation		
	Agriculture	Non-agriculture	Total
Previous occupation			
Agriculture	63	2	65
Non-agriculture	4	31	35
Total	67	33	100

Source: Ghana Living Standards Survey (World Bank).
Note: sample size = 5570

These data reveal a significant reverse migration from urban (or nonagricultural) to rural (agricultural) occupations since the reform program was initiated in the early 1980s. Among individuals that have changed occupations during the period, those moving from nonagricultural into agriculture outnumber those moving in the opposite direction two-to-one. Given the proportions of the rural and urban populations as a whole (and assuming it is roughly the same for the agricultural-to-nonagricultural breakdown) these data indicate a two-percent net increase in the share of the population earning a living in agriculture since 1984. This contrasts with aggregate data prior to 1984 indicating migration in the other direction at about 1 percent per year. The impact of this reversal on productivity of both food and export agriculture appears to have been considerable: In the late 1980s Ghana substantially improved food production and dramatically increased cocoa exports (figure 17 below).

These data confirm what many observers have suspected or observed anecdotally; that government policy has a profound effect on migration from rural to urban areas. As a corollary, these policies have also had an important effect, both directly and indirectly, on the growth in Africa's food imports.

IV. DIVERSITY WITHIN AFRICA: POLICY ENVIRONMENT AND AGRICULTURAL PERFORMANCE

The pattern for individual countries will vary from the average relationships described above. And the responsiveness of agriculture to changes in price and nonprice variables will certainly differ across countries. To some extent this will depend on the type of policies pursued, whether farmers anticipate policy changes to be permanent or temporary, as well as structural factors such as the state of transport and other infrastructures. Recent debate on the effectiveness of policy reforms and adjustment programs has focused both on what evidence there is to indicate that these programs are working, and on to what extent can one expect adjustment programs to be equally effective in different countries.

To try to address these two questions, and to provide evidence complementary to the patterns and results above, this section will examine the patterns for countries grouped according to their policy environment, and it will examine a number of individual countries as well. The emphasis on the comparison of country groupings is to discern evidence of divergent trends between those countries pursuing policy reform programs and those that do not.

Comparing performance in favorable versus unfavorable policy environment

One approach to addressing the importance of the policy environment empirically is to compare the performance of countries that have pursued policies favorable to agriculture, with that of countries whose policies have been less favorable to agriculture. Although the set of domestic policies which impinge on the agricultural sector differs by country, key policy variables can be used to create this typology. The approach taken here is to compare countries which have maintained or adopted a policy environment favorable to the agricultural sector. The classification is based primarily on two variables, exchange rate policies and producer pricing policies. Thus, by examining 1) the extent of exchange rate distortion -- revealed in the real exchange rate and the ratio of parallel market exchange rate to official rates -- and 2) the trends in real prices paid to producers as well as the nominal protection coefficient, the countries in Sub-Saharan Africa have been classified as those with a Favorable Policy Environment (FPE), and those with Unfavorable Policy Environments (UPE) which hinder or discriminate against agriculture. The classification and criteria used are given in Annex C.

Differential performance between groups. The comparisons in table 8 indicate that since the early 1980s the countries with favorable policies have performed better than those with unfavorable policies. This has been true in agriculture, and in terms of overall economic growth as well. Between 1982 and 1988, agricultural exports and agricultural value-added rose in FPE countries 4.15 percent and 3.50 percent per year, respectively, while both of these indicators declined in UPE countries. Total agricultural production grew nearly three times as fast in FPE countries, and food production grew nearly 4 times as fast, as was the case in the UPE countries. Given the importance of agriculture and its linkages to other sectors, it is not surprising that overall GDP also grew faster in FPE countries -- at 3.25 percent per year -- over the 1982-88 period. Since

Table 8. Comparison of performance and policy among African country groups.

	Countries with favorable policies			Countries with unfavorable policies		
	average 1980-82	average 1985-88	growth rate 1982-88	average 1980-82	average 1985-88	growth rate 1982-88
Economic Performance						
Volume of agricultural exports a/c/	99.1	121.5	4.15	101.8	102.8	-1.80
Total agricultural production a/	104.2	118.3	2.55	102.9	109.1	0.89
Food production	103.9	116.5	2.33	103.3	107.7	0.62
Agricultural Value-added a/c/	101.5	119.7	3.50	101.7	99.4	-0.91
Gross domestic product a/	103.9	125.6	3.25	104.1	118.4	2.14
Policy Performance						
Real effective exchange rate b/	133.0	95.6	-9.4	168.2	112.4	-5.3
Real producer prices for exports a/c/	94.3	104.9	4.37	95.8	96.5	0.85
Nominal protection coefficient (export commodities) c/	0.84	1.14		0.96	0.99	
Real protection coefficient (export commodities) c/	0.65	1.12		0.75	0.97	
Food Sector						
Real producer food price c/	98.4	100.6		104	108	
Nominal protection coefficient (tradeable foods) d/	2.9	1.4		0.74	1.27	
Real protection coefficient (tradeable foods) d/	1.18	1.97		0.63	1.03	
Food imports c/	106	133	5.5	112	160	4.5
Exogenous Factors						
Index of export prices a/	99.1	87.1		97.8	89.8	
Weather effect	-0.06	0.05		0.02	-0.05	

a/ Index, 1979-81 = 100.
b/ Index, 1970-75 = 100.
c/ Period is 1985-87 only, no 1988 data are available.
d/ Periods are 1981-83, and 1987 only. Reduced samples are 6 and 4 for FPE and UPE, respectively.

1984, growth in the FPE countries has exceeded population growth for all the performance variables mentioned above. The divergent trends are illustrated in figures 11-14. 24/

The policy variables in table 8 mirror the way the countries were classified: FPE countries have, on average, reduced real effective exchange rates rapidly since 1982, nearly twice as fast as the UPE countries, and to a level lower than during the early 1970s whereas for the UPE countries' the REER remains 12 percent higher than in the early 1970s (figure 15). 25/

With respect to direct policies affecting agricultural incentives, the average nominal protection coefficient for major export crops in FPE countries rose to 1.14 by 1985-87 from a level of 0.84 in the early 1980s. In UPE countries the NPC rose as well, but by a lesser amount, to 0.99. Since the NPC does not account for the indirect effects of exchange rate distortions, the real protection coefficients (RPCs) are compared between the two groups. They indicate that in the early 1980s, producers in FPE countries were faced higher rates of implicit taxation than did those in UPE countries. Since that time the pattern has shifted in favor of producers in FPE countries as the RPCs for that group rose 70 percent. 26/

For the FPE group, the level of RPC in 1985-87 indicates some degree of subsidization to producers. Indeed, among CFA countries, governments have been unwilling to reduce producer prices in the face of the decline in the French franc denominated prices of their major commodity exports. This has for example resulted in an RPC of 2.56 for Senegal, and 1.15 for Cote D'Ivoire.

Exogenous factors and shocks. Exogenous factors such as better weather patterns or higher demand for a country's exports could potentially explain some or all of the differential performance observed here. To assess that possibility both a weather variable, and export prices are compared for the two groups of countries. In the case of export prices, the data suggest that export prices facing both groups of countries have fallen by similar magnitudes.

To assess the impact of rainfall, the weather variable defined in Section 2 is used: deviation from trend in cereal yields. Those residuals (in logarithms) are compared in table 1 for the two groups of countries. They indicate that, on average, FPE countries did indeed receive more favorable weather during 1985-87, but faired somewhat worse in the early 1980s (figure 16).

Can the differences in performance between the two groups be explained by the better weather experienced by the FPE countries? This question can be answered in a precise way. Since the relationship between the weather variable and exports was estimated in table 1, it was also estimated with respect to total production and food. Based on the estimated coefficients of the

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24/ Performance varied within the two groups. Not all FPE countries performed better than all UPE countries, but in the case of agricultural value added, for example, of the 12 countries with growth rates above 2 percent, 9 were FPE countries; of the 11 countries with growth rates below 2 percent 9 were UPE countries. For agricultural exports the dispersion overlapped more; in fact Senegal, a FPE country, had the worst performance with -12 percent growth for 1982-87.

25/ This improvement for FPE countries occurred in spite of an increase in REERs by CFA countries of about 1 percent per year from 1982-87.

26/ The actual level of the "real" protection coefficient may be misleading if the real exchange rate was distorted in the base year. Attention, therefore, should be focused on the change over time and difference between the NPC and the "real" protection coefficient.

Figure 11. Africa's agricultural exports
Comparing countries grouped by favorable
and unfavorable policy environments

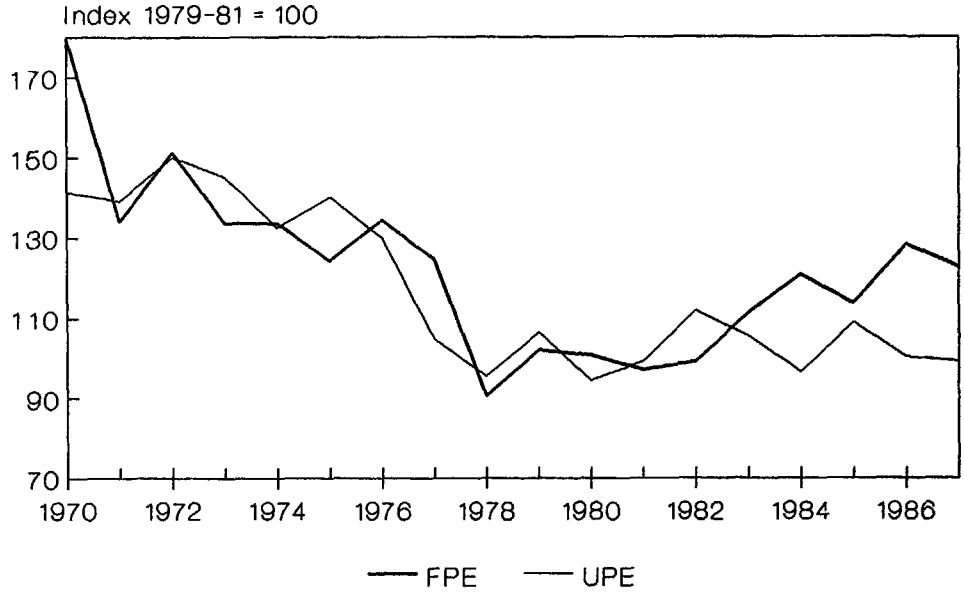


Figure 12. Total agricultural production
Comparing countries grouped by favorable
and unfavorable policy environments

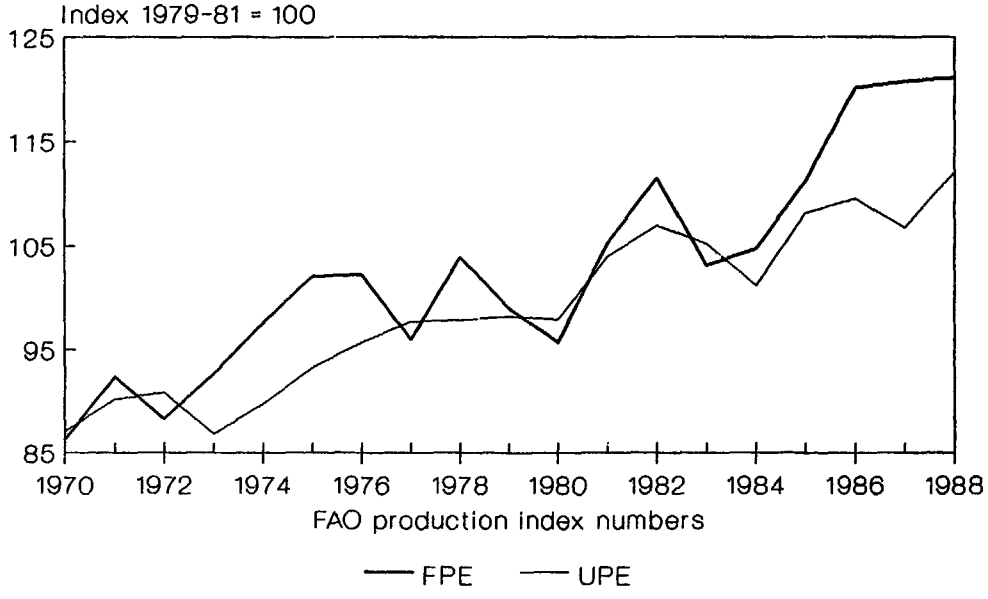


Figure 13. Total food production
Comparing countries grouped by favorable and unfavorable policy environments

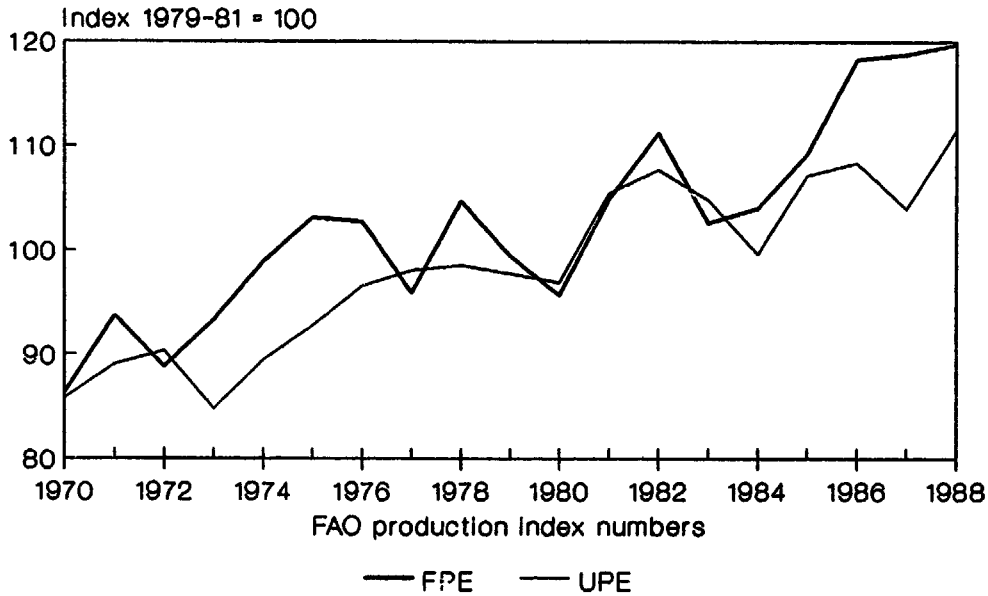


Figure 14. Africa's GDP
Comparing countries grouped by favorable and unfavorable policy environments

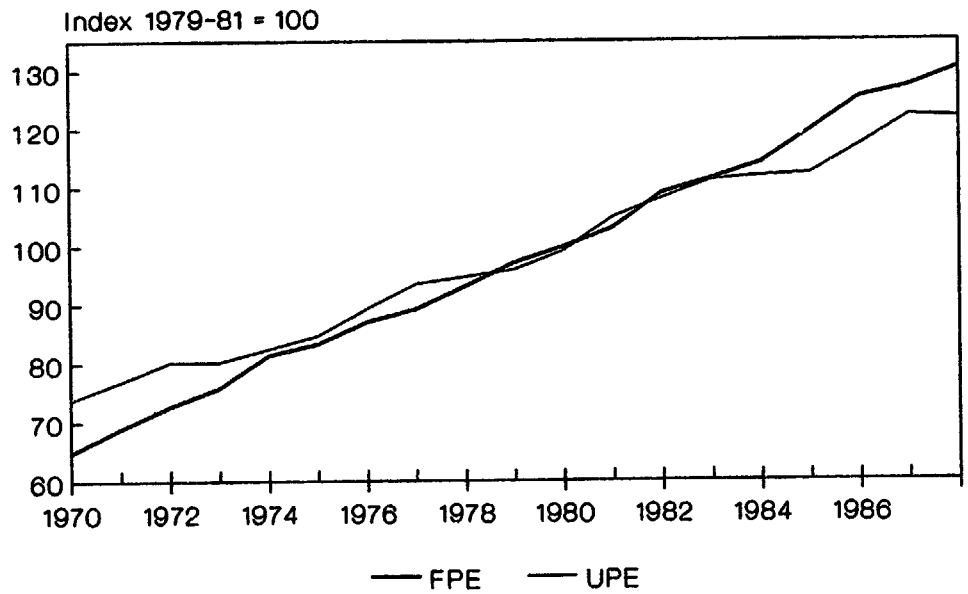


Figure 15. Real effective exchange rates
Comparing countries grouped by favorable
and unfavorable policy environments

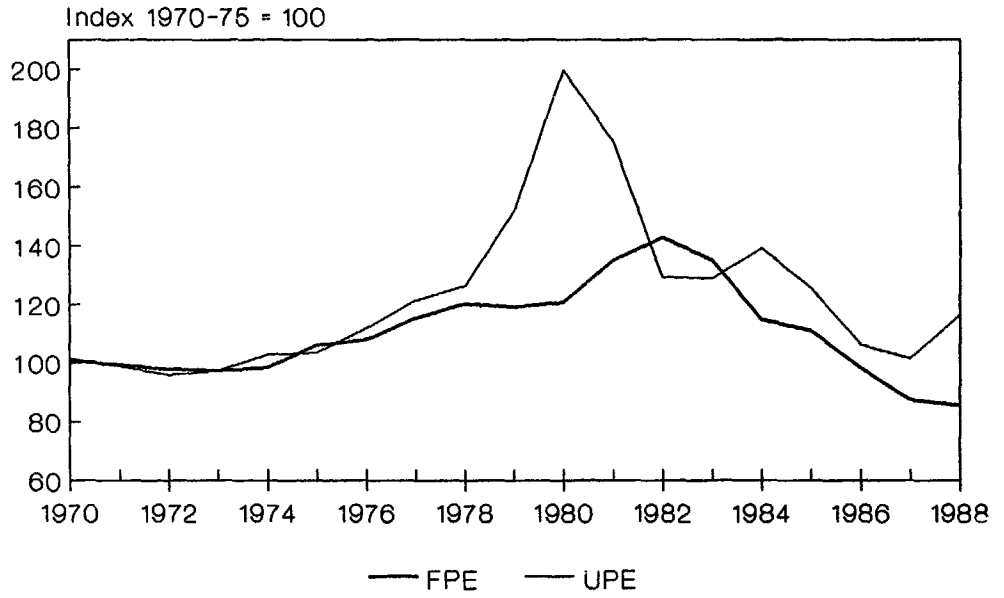
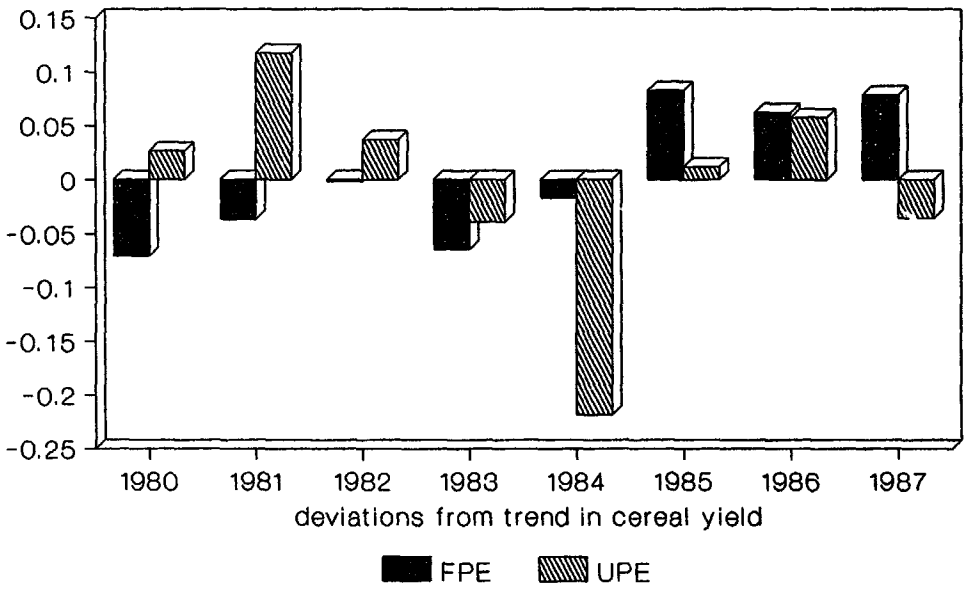


Figure 16. Weather patterns in Africa
Comparing countries grouped by favorable
and unfavorable policy environments



regressions in table 1, only about one-third of the differences in export growth between the two groups or countries can be attributed to differences in rainfall. 27/

The comparisons in table 9 also indicate that both food and total agricultural production grew faster since 1982 in countries with favorable agricultural policies -- with food production growing nearly four times as fast in FPE countries as in UPE countries. Again, based on the coefficients estimated for their response to better weather, only about one-third of the difference can be attributed to the different weather patterns.

It is noteworthy that for those countries where producer food price data are available (excluding official prices where they are not enforced) there has been very little change in the real prices paid to producers for food crops. Again the earlier results are confirmed: improved prices for export crops tend to benefit food production as well.

Country diversity: policy and response

While the patterns in many individual countries support the aggregate results and grouped comparisons above, performance and responsiveness varies across countries within the two groups. Aside from differentiation between annual and tree crops, two major reasons can account for differing responsiveness to price signals: first, if price changes are viewed as temporary fluctuations rather than permanent shifts in the price policy regime, farmers will not respond; second, nonprice constraints may obstruct producers from responding to incentives.

The experience of several countries provides evidence of both responsive and nonresponsive agriculture. Ghana is a striking example of both how deleterious the effects of bad economic policies can be, and how changing those poor policies can have a dramatic effect for agriculture and for the economy overall. GDP has grown by 6 percent per year since 1983, led by the agricultural sector. Agricultural exports (essentially cocoa), which had been falling since the 1960s, have finally rebounded, 3-4 years after real producer prices were nearly doubled (figure 17).

There are many reasons for the impressive response of Ghana's economy. Included among these are the return of expelled workers from Nigeria at the time of the reforms bringing additional labor to the rural sector, high levels of international assistance which enabled the government to persevere in the difficult adjustment programs, and the ostensible perception that the reforms represented a permanent change in Ghana's policy regime. A survey carried out in early 1988 showed a substantial amount of new cocoa planting was taking place, an investment whose return will depend on producer prices at least four years hence. The credibility of the change in price level had been perceived (accurately thus far) to be a permanent change and thus led to revision of the prices expected by farmers in the future, not just current prices.

In addition, though, despite a long period of deteriorating economic conditions, the physical and institutional infrastructure needed to service the cocoa sector had remained reasonably intact.

27/ Using the estimate of the export supply response to changes in the weather variable, only 4 percentage points of the 22 percent growth over the period can be explained by more favorable weather. Similarly, for the UPE group which experience poor weather during part of the period, their exports could have been 3 percentage points better than the 1 percent rise between the two periods if weather had remained favorable in the second period. Therefore, 7 of the 21 percentage point difference in growth between the two groups is accounted for by different weather. (Similar results are obtained by comparing the differences in total production and food production.)

Figure 17. Ghana's price incentives and agricultural exports

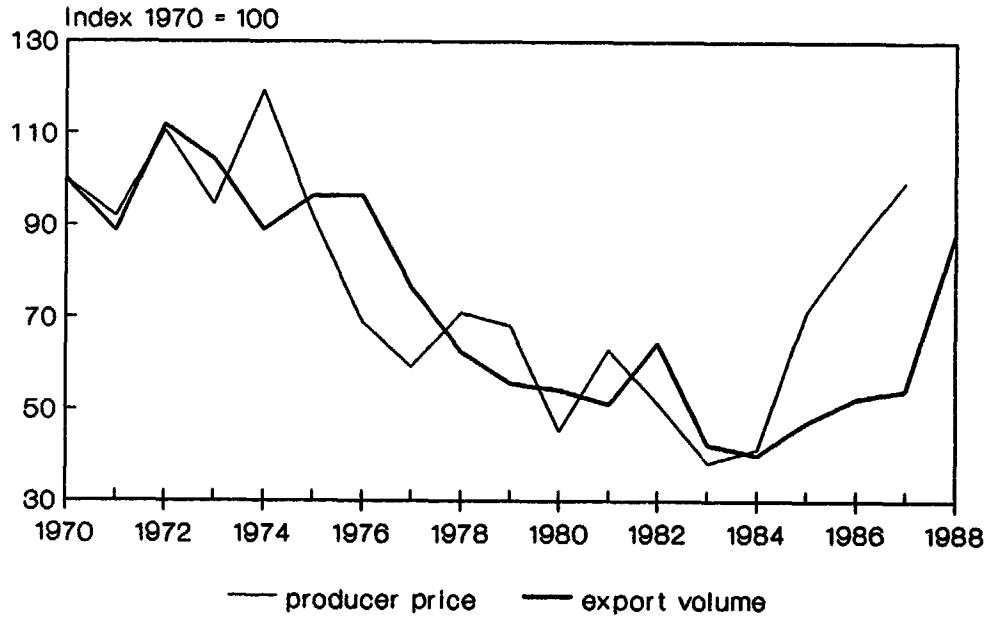
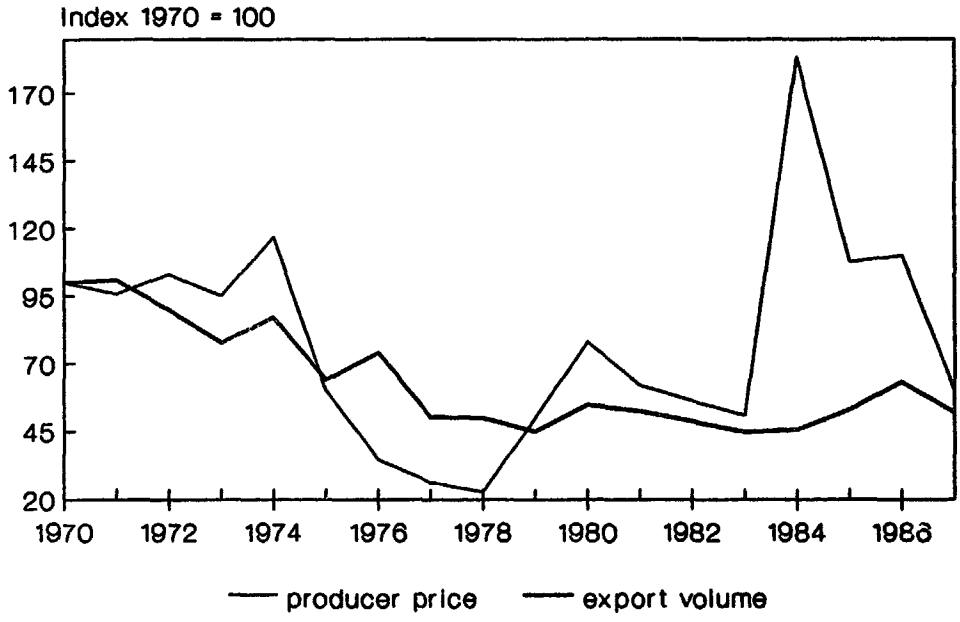


Figure 18. Zaire's price incentives and agricultural exports



Some roads are in need of repair, but for the most part the capacity existed to support the response in the sector. These nonprice factors were, in Ghana's case, not as limiting to agricultural response as may be the case elsewhere. Togo also provides an example where agriculture has been responsive to incentives (figure 20).

By contrast, Zaire is a case where policy reform led to strong policy changes, but had little effect on production. The improvement in incentives, however, was shortlived (figure 18), and to the extent that producers (correctly) viewed the change transitory rather than a credible shift in policy regime, they were unresponsive to the change. The potential responsiveness of agriculture in Zaire is less clear for other reasons. The interior transport network, as well as support services to agriculture were never as well developed as in Ghana, and they have deteriorated considerably. The loss of this infrastructure, combined with the policies that weighed heavily on taxation of agriculture, resulted in a degeneration to essentially subsistence agriculture. Recent analysis of the situation in Zaire refers to a labor shortage in the rural areas due to low returns to agriculture, lack of consumer goods, and cheap food policies favoring the urban areas: quite simply agriculture will not respond to price incentives if few people live in rural areas!

Similar to Zaire in many respects, Tanzania provides another example of disappointing response to policy reforms. While the policy distortions over the past 20 years have been very severe (Lofchie), recent policy reforms in Tanzania have resulted in little response from agriculture. There appear to be two main reasons for this. First, the reforms have yet to result in sustained improvements in the incentives facing producers. Exchange rate distortions remain, and real producer prices have not improved (figure 19). For investment to occur in agriculture, prices expected in the future must be revised. If even current prices have not risen, it is unlikely to change behavior. Secondly, the physical infrastructure had decayed substantially in Tanzania, leaving many producers, or potential producers, without easy access to the markets that are intended to foster incentives.

Many observers have remarked at the striking differences in performance between Kenya and Tanzania. The differences are clearly related to differences in policy. Kenya's coffee and tea growers have enjoyed high percentages of their crops international price (NPCs have averaged 0.9 for both), although this leaves farmers vulnerable to wide year-to-year swings in the prices they receive. Nevertheless, there has been steady growth in export volumes of both crops.

Land policy in Kenya, and the Ujaama policy in Tanzania are just two additional factors that enter into understanding the sources of the two countries differences. The complexities of the differences and similarities of these two countries are, however, impossible to summarize briefly. 28/ One key difference, though, is the identification of key constituencies for policy making: Kenya's farmer elites, and Tanzania's urban elite. In Kenya, the elite has financially invested in rural areas, often deriving an important portion of its income from agriculture. Their influence has undoubtedly been a factor in the consistent policy environment that has favored agriculture.

By contrast, the Tanzanian government nationalized the land, making it virtually impossible for agricultural systems based on private ownership to develop, and the government's leadership code

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28/ See Michael Lofchie, 1989. The Policy Factor: Agricultural Performance in Kenya and Tanzania for a recent analysis of the economic and political issues.

Figure 19. Tanzania's price incentives and agricultural exports

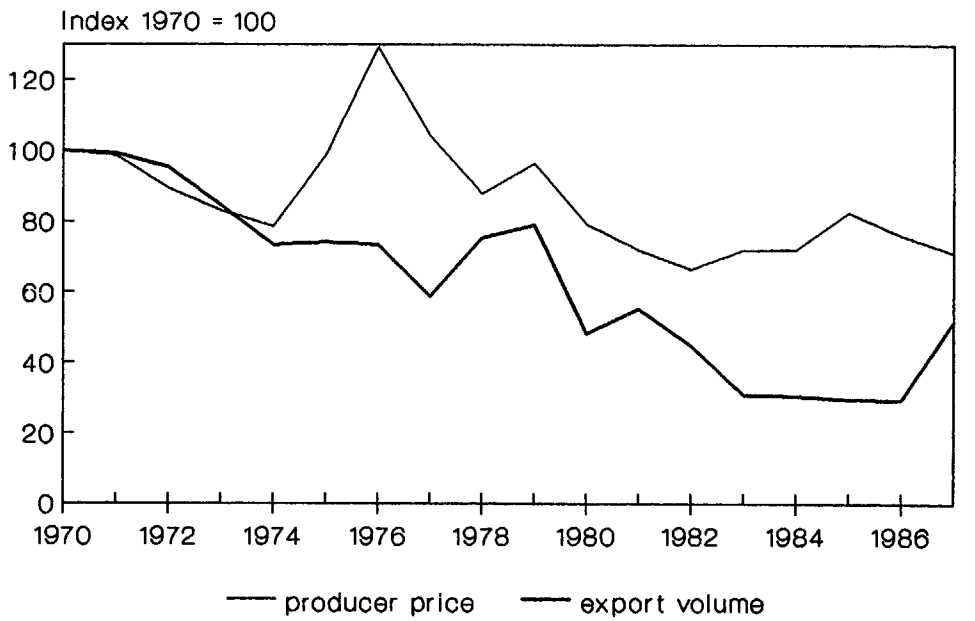
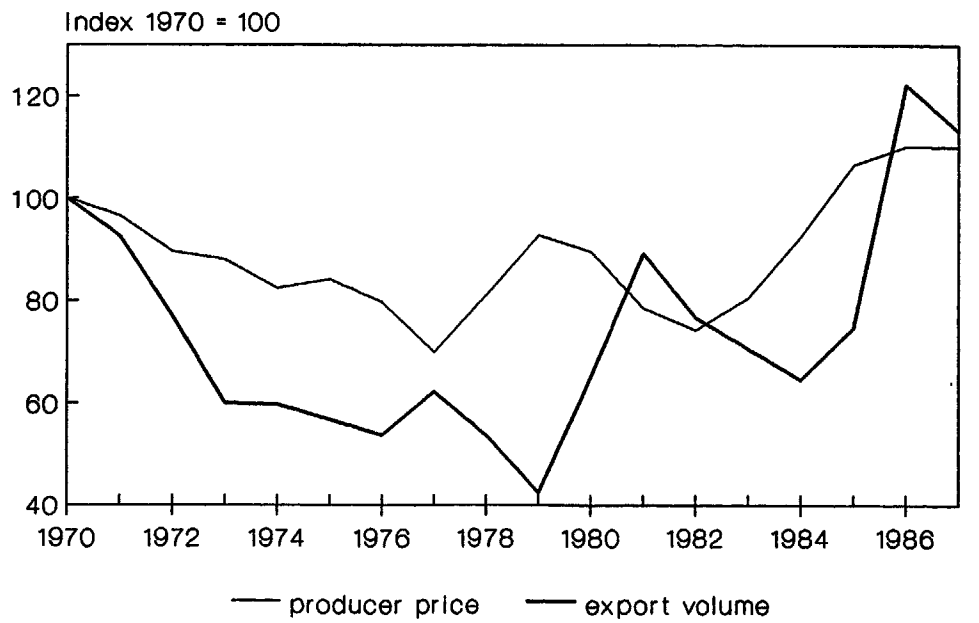


Figure 20. Togo's price incentives and agricultural exports



"framed and implemented by politicians whose political and economic base was exclusively urban. Tanzania's agricultural policies thus provide one of Africa's clearest examples of a system designed to transfer economic resources from the countryside to the city" (Lofchie, p. 191).

Indeed, many of the African countries where agriculture has been favored and as a result performed well, are countries where influential elites have vested interests in the agricultural sector: Kenya, Malawi, and Zimbabwe, are all countries with large-scale farms owned by influential citizens. By contrast, in the majority of African countries where the sector is made up almost entirely of smallholder farmers with little or no political voice, agriculture has been disadvantaged in favor of the influential urban class.

This adds a confounding factor to the arguments in favor of a broadly-based smallholder development strategy versus a "bimodal" strategy including larger, estate type farms. While the economic arguments for smallholder-based strategies are persuasive (Johnston 1982), one sees in recent experience that they have tended to be politically disadvantaged and suffered as a result. By contrast, where there is an elite with vested interest in agriculture there appears to have been a powerful voice supporting the interest of farmers. Does the importance of assuring a political lobby outweigh the economic arguments for unimodal development? Have the large-scale landholders lobbied for their interests only, at the expense of smallholders? In some cases, there has been a discriminatory influence that has protected the interests of the large-scale farmers, sometimes at the expense of the smallholder, as in the cases of Malawi and Zimbabwe.

V. CONCLUDING COMMENTS

Summary of Empirical Findings

The analysis above supports the following conclusions:

1. The decline in Africa's agricultural exports production between 1970 and the early-1980s coincided with substantial and widespread macroeconomic policy distortions and deteriorating real prices paid to agricultural producers. Detailed econometric analysis indicates that agricultural exports have, overall, been depressed by direct and indirect price distortions. The effects have been substantial; aggregate patterns indicate that as both real producer prices and real exchange rates deteriorated by about 20 percent on average during the 1970s, agricultural exports declined by a similar percentage.

2. Beginning in the early 1980s, policy reforms and macroeconomic adjustments have reduced the degree of direct and indirect policy distortion giving rise to improvements in overall agricultural export performance. The estimates of supply responsiveness confirm the relationship between improved policies and better growth. Moreover, countries that have adopted or maintained favorable policy environments since 1984 have seen higher agricultural production, exports, and overall economic growth than countries with less favorable policies.

3. The degree of policy distortion in Africa differs from other developing countries primarily with respect to exchange rate distortions rather than in direct pricing policy. The degree of direct pricing policy intervention, as measured by the rates of nominal protection, have been significant in many African countries, but they have not been significantly larger than in other developing countries. The degree of exchange rate overvaluation, however, has been

larger, resulting in a loss of competitiveness and leading to inefficiencies, including those arising from the exchange and trade controls that usually accompany overvaluation.

4. The response of export agriculture to policy changes has not come by way of shifting resources out of food production. Econometric analysis indicate that food production, like exports, responds positively to improvements in real exchange rates. Moreover, food production correlates positively with higher producer prices for export crops, suggesting either that they are complements in production, that policies favorable to export agriculture also favor food producers, or that a third, omitted, variable is correlated with both improved policy and output.

5. Urban migration has been both a symptom of policy distortions and a cause of poor agricultural performance. In many African countries, macroeconomic imbalances, declining real producer prices, "cheap food policies", and other policies favoring urban dwellers have shifted the rural-urban terms of trade significantly against the rural sector. This has led to a shift of productive resources out of agriculture and has resulted in high rates of urban migration. Policy reforms that realign the internal terms of trade can slow, or reverse, these resource flows. This has been documented in Ghana where substantial reverse migration to the agricultural sector has been occurring since the implementation of their recovery program.

6. Africa's food imports doubled during the late 1970s, making Africa a net food importer for the first time. In the aggregate, however, this 7 million metric ton increase in annual imports is almost entirely accounted for by two factors: a) seventy percent of the increase is due to a quadrupling of Nigeria's food imports during the oil boom when its "capacity to import" tripled; and b) food aid to Africa increased from annual levels of 1 million metric tons per year to around 4 million metric tons, accounting for most of the remaining increase.

7. At the country level, rising food imports have not resulted from a failure of African agriculture (yields per hectare have, in general, been rising). Slow growth in domestic food production in Africa is primarily the result of urban migration, the availability of cheap food imports, and a tendency among urban dwellers to consume imported rice and wheat. This has resulted in a reduction in the demand for domestically produced foods, which, along with the outmigration of agricultural labor, has led to supply and demand for domestic production growing more slowly than population. Econometric analysis indicates that the most important factors explaining rising food imports are: a) changes in the structure of demand (due to demographic and income changes related to urbanization), b) changes in the ability to pay (foreign exchange earnings or "capacity to import"), and c) relative prices (due to the overvaluation of currencies which have made imported foods relatively cheap). Most of the variation in food imports can be explained by these factors. The remaining trend in food imports is only about a 1 percent annual increase, which is likely the result of the substantial drop in international rice and wheat prices between 1970-86.

Taken together, these conclusions place much of the blame for the deterioration of African agriculture on government policies which have shifted the internal terms of trade strongly against agriculture and created market distortions that reduced efficiency. The result was a shift of resources -- especially labor -- out of the sector, and a decline in both private and public investment.

Forward Looking Issues

The prescription that follows from these findings should not be one of limiting the focus of attention to price policy. But rather it should be clear that the elimination of policy distortions sets the stage for getting on with strengthening the real sources of long-term agricultural growth: productive investment and technological change. In addition to investments by private agents, public investments in physical, human and institutional capital are essential such as transport infrastructure, support services, and agricultural research. All of these seek to raise productivity and reduce the cost of production to make agriculture more competitive.

In specific countries, prices may appear to be less important than nonprice factors; where price policies have not led to major distortions, attention should rightly be placed on promoting productive private and public investments. Where price distortions have been large and as a result agricultural investments neglected, both price and nonprice constraints are likely to be binding, but removing price distortions should be seen as a prerequisite to encouraging appropriate investments in the sector.

The debate over the relative importance of price and nonprice factors is to some degree misguided, or at least misleading. There are three reasons for this. First, nonprice constraints on the responsiveness of agriculture may be interpretable as being price-related (i.e., the lack of roads is a transport cost which will reduce the farmgate price; the absence of extension services raises information costs making technology prohibitively expensive to most farmers). Second, the relative importance of these two categories clearly differs across countries. Therefore, the debate should rightly take place only within a specific country context.

And third, nonprice constraints in many cases may be a reflection of the very slow speed of adjustment for investments, maintenance, migration, and the attention of government to provide supporting services, in response to potentially profitable agricultural activities. In the absence of price incentives, it will do little good to relieve nonprice constraints. In fact, it should be difficult to identify them without proper price signals (in the extreme, it does little good to build roads to rural areas if nobody lives there anymore).

In many cases constraints exist which inhibit a swift response of farmers to changes in prices. But bad roads, lack of irrigated land, and nonexistent input suppliers can be seen as the result of neglected investments in the face of unprofitable choices. The point here mirrors the dicotomy between short-run and (very) long-run supply response. In the same way that planting cocoa trees is a long-run investment decision by a farmer in response to expectations of future profitability, public funds for roads, storage facilities, or establishing institutional support reflect public sector responses to future returns on investment. In this way, the very long-run supply response includes "induced institutional change." Indeed, it should be clear that the highly developed physical and institutional infrastructure of Kenya's coffee sector would not have developed if pricing and exchange rate policies had been strongly adverse. The results presented here make a case for the importance of reducing price policy distortions. Viewed in this way, it should be seen as a necessary but not sufficient condition for agricultural growth.

ANNEX A - DATA AND METHODOLOGY

Time-series data for official and market prices were compiled from a variety of sources including World Bank and IMF documents, consultant's reports, the FAO, the USDA, the International Federation of Agricultural Producers, and direct contacts with World Bank Resident Missions and country economists. 29/

Producer and consumer price data have been compiled for the most important agricultural commodities in each of 35 countries; for up to four major export commodities, up to three traded food crops, and up to two nontraded staples.

Data for agricultural production and trade are from FAO. National accounts data are from the World Bank data files and IMF. Transport costs per kilometer-ton have been estimated based on the large number of existing detailed studies, and are applied to distances from the major producing and consuming region for each commodity via the most commonly used mode. Historical transport cost data, where unavailable, are extrapolated on the basis of the domestic CPI. Processing costs have been estimated similarly. Ocean freight costs are estimated based on World Bank figures.

The critical distinction between official prices and open market or parallel market prices has been maintained throughout. Where the available information indicates that most farmers receive the official price for their product, that price is also assumed to be the market price. Where data on open or parallel market prices are available these prices are used as being more representative of what producers receive. Averages across countries for export or food crops are taken as weighted averages (by production value) within countries, and simple averages across country groups. 30/

For comparative analysis between country groups, group averages are simple means. Weighted averages would be inappropriate since the objective is to illuminate a central tendency among countries in the group, rather than to assess their aggregate magnitude.

The producer price data assembled are deflated by the domestic CPI for up to four major export commodities in each country. An average index of export producer prices is computed weighing each commodity's price by its relative value of total production.

The following potential data problems should be borne in mind when interpreting the results of this study:

1. Production data and, to a lesser extent, export data, may be inaccurate. Export data be

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29/ In general, the producer price data reflect the average annual price received by farmers in the most important producing regions, although due to the wide regional and seasonal variations and the lack of specifics from some sources, this level of precision cannot be assured. Data series from different sources have sometimes been spliced when they seemed reasonably consistent.

30/ Detailed data on producer prices was compiled for 35 countries, excluding very small countries (Comoros, Seychelles, Cape Verde, Sao Tome, Lesotho, Swaziland), ones where no data were available (Angola), or where agriculture is of minor importance in the overall economy (Gabon, Djibouti).

biased when shifts in the share of unreported or smuggled exports changed. This could have resulted in an positive bias in the results above.

2. The producer price data have been carefully compiled to distinguish between official prices and actual producer prices where divergences were apparent. Nevertheless, the prices used are for most countries officially reported prices and in some cases will not accurately reflect what farmers are being paid.

3. The index of producer prices computed is based on from 1 to 4 export crops per country. For countries where the composition of exports includes significant other crops, the price incentives are omitted from the analysis, while their export volumes are included.

4. Changes in input prices have been ignored. To the extent that producers are responding to changes in farm profits, changes in fertilizer and other prices should be taken into account. Typically, higher output prices and devaluation have been associated with raising the prices for imported inputs such as fertilizer. To the extent that this phenomenon has been omitted from the above analysis, the elasticities with respect to price and exchange rate have been biased downward.

5. There are simultaneity problems for countries where their exports account for a sizable share of international markets and face less than perfectly elastic demand (Ghana, Cote d'Ivoire, Nigeria, Kenya, Cameroon). This problem could bias the results downward. For countries where the farm price reflects the highly variable international price (coffee in Kenya and Ethiopia, tobacco in Malawi), occasional sharp increases in price will not affect current production decisions, and will be viewed and temporary in nature. This may partly explain the low, or negative, results for these three countries.

ANNEX B - THE EXTENT OF CHRONIC HUNGER IN AFRICA

At the heart of any analysis of food policy in Africa is a concern over the welfare of African people who live in a harsh environment, where rainfall is erratic and where several regions have been prone to drought, especially in the past 15 years. Africa's famines in drought or war prone areas such as Ethiopia, Sudan, Mozambique, and the Sahel, require emergency responses and better global preparedness for the future. But these emergency situations, now referred to as "transitory" food insecurity (World Bank 1986a) are different from the issue of chronic hunger or food insecurity, where people suffer from a continuously inadequate diet caused by inability to acquire food.

There are, however, relatively few reliable statistics with which to asses the prevalence and magnitude of *chronic* hunger in Africa. In Africa and in other developing countries food availabilities are estimated using food balance sheet techniques which estimate availability as a residual, introducing errors which are almost invariably in the direction of understatement. In a thorough analysis of the statistics and methods quantifying nutritional situations, Poleman concluded that

> "With food availability estimates that understated set against requirement figures that overstated, the cards were so stacked that almost all LDCs could be classified as "diet deficit." Redone with truly accurate information, it is probable that few countries would be so classified. Much as the protein gap proved a statistical illusion, the list of diet-deficient countries would be whittled away." (Poleman, p.15)

Given the weaknesses in the data, and their likely biases, the case being made about Africa's chronic food problem, that "average daily caloric intake was 96 percent of requirements in the 1980s" seems a remarkably weak basis on which to assert that the "inadequacy of food manifests itself both at a national level and at the household and individual level" (Serageldin).

The principal evidence that may indicate widespread undernutrition comes from dietary and anthropometric studies showing that a large share of children in Sub-Saharan Africa are stunted. Stunting, however, can result from several causes, including diseases which lead to reduced intake of food and impair the metabolism and absorptive capacity of the individual. And there is a growing consensus among nutritionists that both disease and undernutrition can result in stunting, as well as child morbidity and mortality. In fact, over the past 20 years the infant and child mortality rates have not dropped more in African countries where aggregate food supplies have increased, than in the countries where food supplies have declined (Svedberg).

In a systematic assessment of available evidence Svedberg (1987) concludes that "there is no firm evidence of widespread and severe undernutrition in the African population at large" (p. 87).

But certain patterns observable in Africa seems at odds with the conclusion that "about a quarter of Africa's population ... do not consume enough food to allow an active working life" (World Bank 1988a). The high rate and continuation of rural-urban migration, the growing importation of rice and wheat that in many countries is more costly that domestic cereals, and depressed market prices following abundant harvests suggesting market saturation, are difficult to reconcile with the assertion that in many of these countries 30 to 40 percent of the population are chronically "food insecure."

However, even with adequate "average" food availabilities, chronic hunger may persist if poverty, income distribution, and other factor prevent certain groups from obtaining enough food. These

are issues that need more careful analysis and attention. The evaluations by Poleman and Svedberg suggest that available data overstate the extent of chronic undernutrition, and that reports including strong statements about the severity of the problem have no reliable empirical basis. Clearly, what is needed is better data and more focused analysis on the extent of the problem and its causes.

ANNEX C - CLASSIFICATION OF COUNTRIES BY POLICY ENVIRONMENT

For comparative purposes countries in Sub-Saharan Africa have been classified into two groups based on the policy environment that existed in the mid- to late-1980s. The principal considerations for classification of countries are the direct policies that affect agricultural incentives (the real producer prices, levels of direct taxation i.e. NPC), and indirect policy measures which affect the competitiveness of the agricultural sector vis-a-vis other sectors in the economy and in international markets (real exchange rate).

On the basis of criteria for these key policy variables the countries were classified as shown in the table below as having a Favorable Policy Environment (FPE) or as having an Unfavorable Policy Environment (UPE). This classification differs in several respects from that used recently in (Africa's Adjustment and Growth in the 1980s (World Bank 1989) to compare "strong reforming" and "weak reforming" countries. Policy reform programs differ among countries and, given the kinds of policy changes undertaken they may or may not be expected to have any relatively short-run impact on economic performance overall, or agricultural performance in particular. For example, reforms in public enterprises, government revenue collection, or reduction of government payrolls are all measures that at least partly share the goal of alleviating fiscal imbalances, to reduce deficit financing through money creation that is inflationary, and thereby lead to lower inflation, positive real interest rates, and better allocation of investments to promote efficient growth. These measures have longer-term objectives and therefore cannot be expected to affect productivity in the economy or in the agricultural sector over a five year period.

In addition, the categories of "strong" and "weak" reforming countries rely on formal agreements with Bretton Woods institutions as the criteria for being considered "strong reforming", rather than by having these reform programs manifested in objective policy performance indicators such as the real exchange rate or level of agricultural taxation. As a result of this different approach to classification, several differences arise in the grouping of countries.

First, the FPE category includes countries which have adopted *or maintained* a favorable policy environment, thereby including countries which have not undergone a structured reform program, but where on the basis of these policy performance measures, the need for such a program -- or the detrimental effect of their policies on productivity -- is less apparent (Benin, Burkina, and Cameroon fit this group).

Second, several countries considered to be "strong reformers", on the basis of the policy performance variables examined here, cannot be considered to provide a favorable policy environment, because exchange rate misalignment persists. As a result, Mauritania and Tanzania are considered to provide unfavorable policy environments due to their exchange rate policy which continue to impose heavy indirect taxation on the agricultural sectors, and to make them less competitive with respect to other sectors and in international markets.

Several countries classified as "strong reforming" countries are here also considered to have favorable policy environments, but because the improvements in their policy performance variables are so recent (in 1986 or 1987), they are excluded from the comparisons of performance, since it is too soon to expect any significant response, especially in countries where agricultural exportables are tree crops where production response can take four or five years. These countries are Burundi, Ghana, Guinea, Madagascar, and Nigeria. Malawi is also a recent reformer, but because its agricultural exports are annual crops, a more immediate response can be expected.

Several countries are excluded from considerations due to lack of data, small size, or volatile swings in agricultural exports related to policies and cross-border smuggling of neighboring countries (Benin, Zambia). The resulting classification of FPE and UPE includes 12 countries in each group. 31/

31/ Angola, Cape Verde, Chad, Comoros, Djibouti, Gabon, Guinea-Bissau, Lesotho, Mozambique, Sao Tome, Seychelles, and Swaziland have been excluded due to their small size or lack of data. The countries excluded from comparisons of performance for other reasons are Burundi, Ghana, Guinea, Madagascar, and Nigeria.

Annex Table C1. Classification of Countries by Policy Environment.

		Real effective exchange rate (1970-73) = 100)			Ratio of parallel market to official exchange rate			Nominal protection coefficient for major exported crops			
	Overall Classification	Average 1984-86	1987	Criterion (below 120 mid-1980s)	Average 1984-86	1987	Criterion (below 1.3)	Average 1984-86	1987	Criterion (above 0.7)	Control of marketing by government
Benin	FPE\a							0.78	1.18	PPE	yes
Botswana	UPE	NA	NA		1.49	1.29	UPE				no
Burkina	FPE	82	78	FPE	1.02	1.01	FPE	0.66	0.92	FPE	yes
Burundi	FPE*	141	111	FPE*	1.31	1.11	FPE*	0.69	0.79	FPE	yes
Cameroon	FPE	114	139	FPE	1.02	1.01	FPE	0.90	1.38	FPE	yes
C.A.R.	FPE	102	107	FPE	1.02	1.01	FPE	0.78	0.99	FPE	partial
Chad	FPE\b				1.01	1.02	FPE				yes
Congo	FPE	93	95	FPE	1.02	1.01	FPE				partial
Cote d'Ivoire	FPE	105	127	FPE	1.02	1.01	FPE	0.79	1.38	FPE	yes
Ethiopia	UPE	162	116	UPE	2.04	2.21	UPE	0.70	0.77	PPE	partial
Gambia	FPE	102	89	FPE	1.17	1.09	FPE	1.11	1.92	FPE	partial
Ghana	FPE*	112	50	FPE*	2.41	1.37	UPE	0.96	0.52	FPE	yes
Guinea	FPE*				9.26	1.04	FPE*	1.79	NA	FPE*	no
Kenya	FPE	90	74	FPE	1.06	1.06	FPE	0.82	0.70	FPE	no
Liberia	UPE	124	105	UPE	1.5 (estimate)			0.89	1.03	FPE	yes
Madagascar	FPE*	96	61	FPE	1.26	0.79	FPE*	0.58	0.70	FPE*	partial
Malawi	FPE*	96	82	FPE	1.37	1.13	UPE	0.63	0.68	FPE*	partial
Mali	UPE	122	118	UPE	1.02	1.01	FPE	0.63	0.68	UPE	yes
Mauritania	UPE	106	92	FPE	2.32	2.30	UPE				
Mauritius	FPE	95	84	FPE							
Mozambique	UPE\b				42.6	12.0	UPE				partial
Niger	FPE	93	79	FPE	1.02	1.01	FPE	1.67	4.02	FPE	no
Nigeria	FPE*	249	50	FPE*	3.94	3.32	UPE	1.03	0.74	FPE	no
Rwanda	UPE	165	185	UPE	1.46	1.27	UPE	0.77	0.97	FPE	yes
Senegal	FPE	105	108	FPE	1.02	1.01	FPE	1.12	2.62	FPE	yes
Sierra Leone	UPE**	138	91	UPE**	1.62	8.13	UPE	1.14	2.07	FPE	no
Somalia	UPE	198	95	UPE	2.07	1.43	UPE	1.60	1.36	FPE	partial
Sudan	UPE	97	88	FPE	1.97	1.84	UPE	1.60	1.36	FPE	partial
Tanzania	UPE	187	74	FPE*	4.15	2.72	UPE	0.94	ERR	FPE	yes
Togo	FPE	91	91	FPE	1.02	1.01	FPE	0.62	1.16	FPE	partial
Uganda	UPE	140	190	UPE	1.99	1.96	UPE	0.55	0.57	UPE	yes
Zaire	FPE	79	66	FPE	1.04	0.80	FPE	0.66	0.54	UPE	yes
Zambia	UPE \a	62	37	FPE	1.51	1.89	UPE	0.89	1.05	FPE	yes
Zimbabwe	UPE	72	63	FPE	1.70	1.59	UPE	1.11	1.09	FPE	no

Note: FPE = favorable policy environment; UPE = unfavorable policy environment.

\a Excluded from performance comparisons because of volatile exports related to neighboring country's policies.

\b Excluded due to lack of data and adverse political situation.

* Indicates countries adopting favorable policies very recent. In cases where their major agricultural exports are tree crops, no supply response can be expected in the short time since the policy changes. Thus, they have been excluded for purposes of comparising agricultural exports. Where annual crops are involved (Malawi) they remain in the sample for those analyses.

** Sierra Leone's structural adjustment program, begun in 1986 was suspended in 1988.

Annex D table 1. Average nominal protection coefficients for major export commodities.

Country	No. of crops	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Benin	1	0.57	0.56	0.45	0.32	0.69	0.49	0.51	0.64	0.62	0.61	0.57	0.71	0.56	0.53	0.68	1.39	1.03	1.16
Burkina Faso	1	0.65	0.64	0.49	0.39	0.71	0.43	0.40	0.67	0.64	0.59	0.52	0.55	0.41	0.38	0.59	1.24	0.88	0.82
Burundi	1	0.71	0.61	0.52	0.57	0.69	0.24	0.22	0.53	0.51	0.62	0.79	0.73	0.76	0.54	0.58	0.45	0.86	0.79
Cameroon	3	0.97	1.00	0.84	0.70	0.90	0.51	0.31	0.60	0.66	0.66	1.06	0.91	0.72	0.62	0.74	0.89	1.33	1.38
C.A.R.	1	0.64	0.66	0.51	0.36	0.65	0.50	0.52	0.66	0.64	0.59	0.60	0.60	0.50	0.46	0.71	1.55	1.01	0.99
Cote d'Ivoire	3	0.63	0.61	0.64	0.55	0.83	0.53	0.28	0.46	0.54	0.76	0.96	0.82	0.61	0.52	0.60	0.82	1.16	1.38
Ethiopia	1	0.73	0.89	0.76	0.77	0.68	0.79	0.49	0.61	0.57	0.59	0.73	0.71	0.65	0.59	0.65	0.67	0.86	0.77
Gambia	1	0.80	0.90	0.86	0.49	0.84	0.89	0.79	0.70	0.90	1.16	0.91	1.36	0.90	0.52	0.76	1.33	2.00	1.92
Ghana	1	0.64	0.46	0.33	0.22	0.42	0.29	0.16	0.22	0.30	0.55	0.61	2.61	1.96	0.27	0.27	0.33	0.30	0.52
Guinea	1	1.49	1.59	1.61	1.75	2.07	1.11	0.75	1.45	1.52	2.04	2.76	2.41	1.66	1.68	2.16	0.15	1.49	
Kenya	1	0.87	0.98	0.93	0.91	0.91	1.03	0.77	0.89	0.92	0.89	0.76	0.79	0.88	0.82	0.88	0.77	0.88	0.70
Liberia	3	0.93	0.81	0.56	0.74	1.04	0.57	0.62	0.68	0.63	0.80	1.13	1.00	0.70	0.79	0.91	0.79	0.91	1.03
Madagascar	3	1.11	1.10	1.16	0.94	1.33	0.66	0.34	0.50	0.51	0.63	0.81	0.66			0.46	0.39	0.56	0.69
Malawi	2	0.81	0.84	1.12	0.92	0.33	0.73	0.72	0.91	0.74	0.66	0.44	0.61	0.68	0.72	0.63	0.67	0.89	0.68
Mali	1	0.50	0.51	0.40	0.30	0.68	0.40	0.38	0.56	0.59	0.63	0.55	0.61	0.45	0.42	0.55	1.20	0.64	0.68
Nigeria	1	0.94	0.95	0.45	0.36	0.65	0.61	0.28	0.49	0.53	0.65	1.16	1.27	1.03	0.86	0.83	0.67	1.41	0.74
Rwanda	1	0.74	0.71	0.62	0.54	0.73	0.36	0.22	0.56	0.54	0.62	0.78	0.72	0.77	0.67	0.65	0.56	1.22	0.97
Senegal	2	0.65	0.84	0.71	0.37	0.80	0.90	0.72	0.64	0.76	0.97	0.67	1.09	0.71	0.47	0.56	1.94	2.39	2.62
Sierra Leone	1	1.07	1.06	0.94	1.06	1.19	0.45	0.31	1.10	0.98	1.34	1.70	1.15	0.75	1.15	1.09	0.84	1.29	2.07
Somalia	1	1.21	1.03	1.16	1.36	0.77	0.94	0.89	0.94	0.81	0.63	0.74	1.01	0.62	0.95	0.75	0.97	1.06	1.03
Sudan	1	1.51	1.43	0.95	1.05	1.52	1.19	1.36	1.69	1.58	1.40	1.57	1.59	1.21	1.46	1.24	2.40	1.71	1.38
Tanzania	2		0.80	0.55	0.54	0.82	0.51	0.59	0.69	0.80	0.68	0.85	0.99	0.95	0.88	1.19	1.12	0.81	
Togo	3	0.77				0.54	0.36	0.22	0.33	0.38	0.52	0.61	0.60	0.44	0.42	0.49	0.73	1.02	1.16
Uganda	2	0.42	0.45	0.39	0.38	0.53	0.40	0.25	0.51	0.94	0.97	1.57	0.63	0.47	0.32	0.38	0.31	0.17	0.57
Zaire	1		0.84	0.91	0.86	1.41	0.31	0.16	0.36	0.19	0.54	1.23	0.91	0.42	0.22	0.68	0.41	0.55	0.54
Zambia	2	1.24	1.26	1.14	1.27	1.27	1.20	1.11	1.36	1.24	1.13	1.09	1.39	1.12	0.91	0.74	0.80	0.47	1.05
Zimbabwe	2	1.01	1.16	1.13	1.13	1.31	1.01	1.09	1.08	0.98	0.90	0.67	1.36	1.08	1.03	0.91	1.28	1.23	1.09

Annex D Table 2. Nominal protection coefficient for principal export commodities.

Country	Crop	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Burkina Faso	Cotton	0.65	0.64	0.49	0.39	0.71	0.43	0.40	0.67	0.64	0.59	0.52	0.55	0.41	0.38	0.59	1.24	0.68	0.92
Burundi	Coffee	0.71	0.61	0.52	0.57	0.69	0.24	0.22	0.53	0.51	0.62	0.79	0.73	0.76	0.54	0.56	0.45	0.96	0.79
Cameroon	Coffee	1.28	1.29	1.29	1.13	1.34	0.66	0.39	0.87	0.91	1.13	1.52	1.16	0.92	0.81	0.98	0.96	1.80	1.67
C.A.R.	Cotton	0.64	0.66	0.51	0.36	0.85	0.50	0.52	0.66	0.64	0.59	0.60	0.60	0.50	0.46	0.71	1.55	1.01	0.99
Congo	Cocoa	0.73	0.65	0.40	0.30	0.44	0.24	0.17	0.23	0.27	0.40	0.41	0.44	0.32	0.25	0.29	0.43	0.63	0.73
Cote d'Ivoire	Coffee	1.11	1.09	1.09	1.06	1.46	0.67	0.36	0.64	0.77	1.09	1.44	1.08	0.80	0.72	0.86	0.86	1.65	1.98
Ethiopia	Coffee	0.73	0.89	0.78	0.77	0.88	0.79	0.49	0.61	0.57	0.59	0.73	0.71	0.65	0.59	0.65	0.67	0.86	0.77
Gambia	Groundn	0.80	0.90	0.66	0.49	0.84	0.89	0.79	0.70	0.90	1.18	0.91	1.36	0.90	0.52	0.76	1.33	2.00	1.82
Ghana	Cocoa	0.64	0.46	0.33	0.22	0.42	0.29	0.16	0.22	0.30	0.55	0.81	2.81	1.96	0.27	0.27	0.33	0.30	0.52
Kenya	Coffee	0.87	0.96	0.93	0.91	0.91	1.03	0.77	0.89	0.92	0.89	0.76	0.79	0.88	0.82	0.86	0.77	0.96	0.70
Liberia	Rubber	0.85	0.66	0.32	0.63	0.96	0.52	0.62	0.53	0.46	0.56	0.75	0.67	0.51	0.71	0.80	0.74	0.63	0.74
Madagascar	Coffee	1.32	1.31	1.36	1.12	1.58	0.77	0.39	0.58	0.59	0.73	0.97	0.79	0.64	0.47	0.54	0.46	0.67	0.83
Malawi	Tobacco	1.34	1.39	1.95	1.63	0.47	1.22	1.17	1.45	1.17	1.02	0.62	0.96	1.12	1.02	0.91	0.96	1.05	1.09
Mali	Cotton	0.50	0.51	0.40	0.30	0.68	0.40	0.38	0.56	0.59	0.63	0.55	0.61	0.45	0.42	0.55	1.20	0.64	0.68
Nigeria	Cocoa	0.94	0.95	0.45	0.36	0.65	0.61	0.28	0.49	0.53	0.85	1.16	1.27	1.03	0.86	0.83	0.97	1.41	0.74
Rwanda	Coffee	0.74	0.71	0.62	0.54	0.73	0.36	0.22	0.56	0.54	0.62	0.78	0.72	0.77	0.67	0.65	0.56	1.22	0.97
Senegal	Groundn	0.65	0.86	0.72	0.37	0.90	0.91	0.73	0.65	0.77	0.99	0.68	1.11	0.72	0.48	0.56	1.98	2.47	2.71
Sierra leone	Coffee	1.07	1.06	0.94	1.06	1.19	0.45	0.31	1.10	0.98	1.34	1.70	1.15	0.75	1.15	1.09	0.84	1.28	2.07
Somalia	Bananas	1.21	1.03	1.18	1.36	0.77	0.94	0.89	0.94	0.81	0.66	0.74	1.01	0.82	0.85	0.75	0.97	1.06	1.03
Sudan	Cotton	1.51	1.43	0.85	1.05	1.52	1.19	1.36	1.69	1.58	1.40	1.57	1.59	1.21	1.46	1.24	2.40	1.71	1.36
Tanzania	Coffee	0.85	0.76	0.56	0.57	0.49	0.41	0.43	0.52	0.39	0.55	0.71	0.65	0.63	0.63	0.74	0.44	0.44	
Togo	Cocoa	0.76	0.72	0.43	0.29	0.44	0.27	0.15	0.19	0.25	0.42	0.47	0.49	0.35	0.32	0.35	0.57	0.75	0.88
Uganda	Coffee	0.38	0.40	0.38	0.36	0.51	0.38	0.15	0.40	0.63	0.63	1.51	0.56	0.41	0.28	0.30	0.23	0.16	0.53
Zaire	Coffee		0.94	0.91	0.86	1.41	0.31	0.18	0.36	0.19	0.54	1.23	0.91	0.42	0.22	0.86	0.41	0.55	0.54
Zambia	Tobacco	1.10	1.22	1.46	1.46	1.02	1.22	0.93	1.16	1.09	1.07	0.97	1.31	1.16	1.00	0.73	0.44	0.45	1.06
Zimbabwe	Tobacco	0.87	1.04	1.20	1.02	1.13	1.01	0.88	0.92	0.85	0.73	0.85	1.24	0.93	1.00	0.81	1.04	1.22	0.88

Annex D Table 3. Real protection coefficients for principal export commodity.

(1971=100 for real exchange rate)

Country	Crop	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Burkina Faso	Cotton	0.65	0.68	0.51	0.43	0.72	0.54	0.43	0.73	0.66	0.60	0.58	0.63	0.49	0.48	0.72	1.56	1.16	1.09
Burundi	Coffee	0.71	0.67	0.58	0.60	0.72	0.26	0.26	0.60	0.47	0.58	0.62	0.52	0.49	0.38	0.40	0.36	0.89	0.85
Cameroon	Coffee	1.26	1.23	1.17	1.03	1.15	0.58	0.34	0.72	0.78	0.96	1.40	1.10	0.84	0.72	0.84	0.75	1.27	1.21
C.A.R.	Cotton	0.64	0.64	0.50	0.38	0.60	0.48	0.53	0.67	0.61	0.54	0.57	0.57	0.49	0.47	0.71	1.40	0.92	0.86
Congo	Cocoa	0.73	0.62	0.39	0.33	0.44	0.25	0.17	0.22	0.27	0.42	0.43	0.47	0.35	0.26	0.30	0.44	0.64	0.75
Cote d'Ivore	Ccoffee	1.11	1.13	1.07	1.04	1.37	0.64	0.30	0.51	0.56	0.78	1.19	0.98	0.76	0.71	0.84	0.72	1.27	1.50
Ethiopia	Coffee	0.73	0.97	0.84	0.85	0.80	0.75	0.42	0.52	0.47	0.52	0.59	0.53	0.48	0.38	0.35	0.49	0.75	0.66
Gambia	Groundn	0.80	0.90	0.79	0.45	0.74	0.82	0.63	0.59	0.75	0.97	0.78	1.17	0.77	0.48	0.64	1.55	2.19	1.96
Ghana	Cocoa	0.64	0.59	0.37	0.22	0.38	0.18	0.09	0.12	0.19	0.28	0.18	0.51	0.55	0.19	0.25	0.55	0.65	1.16
Kenya	Coffee	0.93	1.11	1.11	1.08	1.08	1.25	0.89	0.96	1.05	1.02	0.92	0.92	1.09	0.96	1.00	1.02	1.32	1.15
Liberia	Rubber	0.65	0.71	0.33	0.60	0.91	0.46	0.60	0.54	0.47	0.54	0.68	0.56	0.41	0.55	0.63	0.67	0.60	0.71
Madagascar	Coffee	1.32	1.29	1.34	1.05	1.44	0.75	0.41	0.62	0.59	0.69	0.87	0.67	0.53	0.46	0.55	0.50	1.08	1.53
Malawi	Tobacco	1.34	1.38	2.23	1.87	0.52	1.36	1.33	1.56	1.23	1.03	0.63	1.03	1.16	1.07	0.95	1.13	1.38	1.33
Mali	Cotton	0.50	0.49	0.35	0.27	0.62	0.38	0.34	0.40	0.47	0.47	0.42	0.51	0.38	0.35	0.43	0.91	0.69	0.82
Nigeria	Cocoa	0.94	0.96	0.50	0.37	0.57	0.44	0.20	0.34	0.35	0.53	0.65	0.69	0.48	0.29	0.31	0.48	2.99	1.48
Rwanda	Coffee	0.74	0.72	0.63	0.52	0.61	0.29	0.17	0.48	0.44	0.52	0.59	0.45	0.45	0.38	0.37	0.35	0.75	0.61
Senegal	Groundn	0.65	0.83	0.66	0.34	0.68	0.60	0.64	0.59	0.70	0.94	0.72	1.15	0.74	0.48	0.52	1.68	2.20	2.58
Sierra Leone	Coffee	1.07	1.07	1.03	1.21	1.43	0.60	0.43	1.48	1.26	1.73	1.90	1.04	0.55	0.69	0.78	0.78	1.41	2.04
Somalia	Bananas	1.21	1.15	1.30	1.39	0.75	0.78	0.74	0.82	0.65	0.37	0.35	0.60	0.33	0.32	0.45	0.90	1.18	0.91
Sudan	Cotton	1.51	1.39	0.94	0.92	1.21	0.95	1.09	1.53	1.45	1.43	1.52	1.67	1.46	1.39	1.28	2.49	1.90	1.37
Tanzania	Coffee	0.65	0.79	0.63	0.59	0.47	0.42	0.48	0.53	0.42	0.52	0.52	0.41	0.35	0.34	0.35	0.29	0.61	0.00
Togo	Cocoa	0.76	0.69	0.42	0.30	0.40	0.25	0.12	0.16	0.22	0.38	0.43	0.47	0.34	0.34	0.40	0.59	0.81	0.99
Uganda	Coffee	0.36	0.45	0.39	0.25	0.35	0.20	0.05	0.10	0.12	0.07	0.16	0.23	0.21	0.21	0.23	0.16	0.09	0.20
Zaire	Coffee		0.82	0.91	0.75	1.11	0.22	0.09	0.14	0.08	0.29	0.71	0.50	0.20	0.26	1.15	0.53	0.64	0.76
Zambia	Tobacco	1.10	1.29	1.55	1.56	1.17	1.35	1.05	1.35	1.28	1.27	1.13	1.37	1.33	1.32	1.04	1.30	1.27	1.93
Zimbabwe	Tobacco	0.87	1.04	1.18	1.08	1.20	1.07	0.93	1.18	1.10	0.94	0.78	1.38	1.16	1.25	1.13	1.60	1.97	0.75

Annex D table 4. Average real producer price for major export commodities.

(Index, 1980 = 100)

Country	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Benin				119	130	131	115	108	104	100	115	108	117	107	109	99	91	
Botswana																		
Burkina Faso	133	131	135	137	144	121	132	140	129	112	100	105	94	98	120	124	128	125
Burundi	101	95	88	93	94	71	110	177	142	108	100	89	85	78	75	71	69	63
Cameroon	94	92	87	85	79	78	85	98	100	105	100	94	89	85	85	86	83	73
C.A.R.					121	105	132	119	107	108	100	89	88	85	96	87	84	102
Chad																		
Congo	89	85	78	80	82	70	91	96	101	107	100	89	85	79	75	71	119	117
Cote d'Ivoire	98	99	99	108	137	123	118	115	113	115	100	95	87	98	103	105	99	94
Ethiopia	125	148	165	165	120	262	269	165	160	133	100	110	87	89	89	108	79	86
Gambia	99	101	104	112	138	130	123	109	104	98	100	102	96	75	85	148	133	90
Ghana	221	203	244	208	283	203	152	131	157	150	100	139	113	85	91	157	190	219
Guinea	28	28	31	33	444	56	69	80	91	107	100	91	77	72	80	78		
Guinea-Bissau																		
Kenya	101	106	111	115	106	174	264	165	135	125	100	109	109	147	125	123	76	81
Liberia	77	62	60	107	103	65	92	91	96	115	100	65	50	59	56	50	52	63
Madagascar	143	138	138	130	129	118	113	119	114	104	100	88	89	82	85	89	88	101
Malawi	159	145	159	183	122	145	178	178	184	147	100	109	119	132	161	120	106	95
Mali	177	147	136	115	153	145	134	124	99	109	100	106	102	107	96	100	103	99
Mauritania																		
Mozambique																		
Niger	80	84	80	81	173	159	129	117	123	110	100	81	131	135	152	185	201	224
Nigeria	85	83	81	91	111	113	92	119	97	102	100	83	77	67	52	52	155	128
Rwanda	121	120	117	105	105	93	87	141	124	107	100	94	84	78	74	73	77	74
Senegal	108	121	114	112	158	120	119	107	103	102	100	122	104	79	70	111	104	109
Sierra Leone	51	52	49	66	72	60	66	137	123	121	100	61	52	73	68	64	143	78
Somalia	242	263	271	255	215	227	199	199	181	145	100	144	137	123	125	172	183	164
Sudan	108	107	97	115	107	94	95	102	103	98	100	108	80	76	74	93	94	86
Tanzania	128	124	113	105	99	125	163	132	111	122	100	91	84	91	91	104	86	80
Togo	112	108	100	98	92	94	89	78	91	104	100	88	83	90	103	119	123	123
Uganda	135	132	133	108	89	108	78	55	78	54	100	168	128	173	248	181	117	104
Zaire	128	122	132	122	150	77	45	34	29	64	100	80	72	65	235	138	141	77
Zambia	117	111	110	141	132	154	129	131	120	111	100	110	110	98	85	106	87	139
Zimbabwe	107	113	114	139	160	130	134	129	140	107	100	167	148	132	121	141	143	98

Annex D table 5. Average nominal protection coefficients for traded food crops.

Country	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Botswana	1.01	0.93	0.74	0.62	0.65	0.58	0.74	0.68	0.74	0.70	0.89	0.99	0.97	0.98	0.97	1.09	1.31	
Burkina Faso												1.01	0.75	0.89	0.97			1.88
Cote d'Ivoire	0.74	0.83	0.63	0.60	0.74	0.74	0.98	1.42	2.07	1.97	1.64	1.63	1.02	0.96			1.38	1.36
Ghana	1.03	0.93	0.84	0.76	1.22	1.58	3.67	4.72	2.86	3.68	6.75	14.36	9.06	5.57	2.77	1.67	1.69	2.31
Kenya	0.64	0.75	0.50	0.43	0.68	0.66	0.84	0.86	0.70	0.79	0.66	0.65	0.66	0.67	0.73	0.90	0.95	0.93
Liberia	1.07	0.94	0.57	0.50	0.75	1.41	1.55	1.19	1.29	1.04	1.53	2.10	2.22	2.37	2.74	2.70	2.15	
Madagascar	0.60	0.64	0.35	0.22	0.53	0.74	0.69	0.66	0.74	0.66	0.52	0.67	0.73	0.78	0.85	0.92	1.08	1.20
Malawi	5.88	25.81	1.09	0.72	1.31	1.89	4.96	6.89	5.74	12.59	12.16	-0.32	-0.47	-0.39	-0.42	-0.30	-0.22	5.00
Mali													0.59	0.85	0.94	0.69	0.48	
Niger																1.70		
Nigeria										1.65	1.50	2.23	2.02	1.49	3.78	2.03		0.78
Rwanda	0.62	0.64	0.51	0.37	0.51	0.50	0.68	0.78	0.64	0.89	0.77	0.69	0.67	0.55	0.78	0.87	0.77	2.16
Senegal													1.19		1.47	1.87		
Somalia																1.50	1.13	
Sudan	1.23	1.16	0.70	0.58	1.06	1.19	1.35	1.19	0.93	0.81	1.05	0.93	0.94	1.06		1.46	1.45	1.11
Tanzania										2.51	3.71	1.44	2.26	4.09	3.20	1.97	1.19	
Togo			1.28	0.78	1.01	1.08	1.72	2.30	1.40	1.16	1.01	2.05	1.59	1.40	1.21	1.20	2.04	
Zambia	0.65	0.78	0.60	0.48	0.58	0.60	0.60	0.63	0.70	0.80	0.80	0.94	0.73	0.69	0.61	0.52	0.64	0.67
Zimbabwe	0.42	0.40	0.30	0.27	0.35	0.32	0.37	0.40	0.35	0.39	0.45	0.60	0.43	0.36	0.39	0.48	0.47	0.92

Annex D table 6. Real producer prices for major food crops.
(index, 1980 = 100)

Country	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Benin					105	107	114	101	101	105	100	93						
Botswana					99	91	85	75	86	80	100	109	114	118	140	134	128	
Burkina Faso	69	67	81	97	109	75	104	112	129	112	100	116	123	122	147	137	70	72
Burundi	112	112	115	113	104	96	99	93	83	87	100	89	88	83				
Cameroon	94	93	89	91	92	102	97	104	102	106	100	103	102		117			
C.A.R.	107	103	96	117	107	92	117	119	107	98	100	89	79	83	110	89		
Chad																		
Congo						100	93	82	108	98	100	107	105	102	97	91	104	
Cote d'Ivoire	109	117	126	122	194	203	195	209	126	115	100	78	82	87	98	97	90	86
Ethiopia	266	227	172	214	221	210	175	164	167	109	100	94	102	101	93	84	87	
Gambia	78	74	68	109	109	113	123	128	123	107	100	104	94	85	82	104	70	57
Ghana	78	79	80	.	98	102	141	146	101	82	100	99	103	178	91	75	72	116
Guinea	30	31	30	33	119	115	114	111	109	97	100	91	87	87	79	176		
Guinea-Bissau																		
Kenya	101	112	108	119	151	140	144	126	97	109	100	97	112	115	110	110	106	101
Liberia	43	43	60	70	59	73	83	78	73	88	100	80	75	73	72	73	58	
Madagascar	76	80	76	72	98	108	103	117	110	107	100	84	81	82	93	96	175	231
Mali	103	95	95	99	105	106	104	103	114	119	100	89	117	120	117	110	95	86
Malawi	107	88	89	75	107	101	93	85	71	79	100	112	114	114	105	105	106	103
Mauritania																		
Mozambique																		
Niger	86	86	78	140	135	124	100	98	118	110	100	142	128	149	172			
Nigeria	125	153	141	134	143	113	103	85	70	110	100	89	83	67	74	101	82	
Rwanda	127	144	138	117	109	93	98	108	103	94	100	99	93	86	88	107	93	80
Senegal	120	110	107	133	114	111	125	111	119	109	100	118	101	100	82	91	97	101
Sierra Leone	73	88	80	76	93	121	82	95	102	98	100	142	112	66				
Somalia	199	191	158	149	136	149	135	138	123	99	100	98	79	97	97	161	133	
Sudan	47	66	54	66	77	95	71	60	79	61	100	95	96	84			51	44
Tanzania	75	69	89	121	130	131	143	147	138	128	100	95	95	97	120	125	114	113
Togo			164	146	137	138	174	212	115	89	100	189	185	184	145	100	122	
Uganda	796	796	773	689	665	744	548	307	225	150	100	540	370					
Zaire						148					100	140	168	155	148	127	136	
Zambia	76	90	85	81	90	95	80	77	82	97	100	105	104	117	112	160	150	108
Zimbabwe	85	77	67	72	88	80	84	87	82	78	100	123	113	94	91	106	93	84

Annex D Table 7. Comparison of estimated transport costs (in $US per ton-kilometer, 1985)

Country	Export Crop	ROAD				RAIL	
		Export Crop		Cereal Crop			
		At official exchange rate	At purchasing power parity exchange rate	At official exchange rate	At purchasing power parity exchange rate	At official exchange rate	At purchasing power parity exchange rate
Benin	Cotton	0.11	0.24				
Burkina Faso	Cotton	0.03	0.08	0.07	0.18	0.04	0.10
Burundi	Coffee			0.13	0.19	0.06	0.11
Cameroon	Coffee	0.17	0.20	0.17	0.20		
C.A.R.	Cotton	0.10	0.17	0.08	0.13		
Chad	Cotton						
Congo	Coffee	0.09	0.11	0.09	0.11		
Cote d'Ivoire	Coffee	0.07	0.09	0.07	0.09		
Ethiopia	Coffee	0.13	0.35	0.10	0.27		
Gambia	Groundnuts	0.12	0.27	0.12	0.27		
Ghana	Cocoa	0.06	0.06	0.06	0.06		
Guinea	Coffee	0.18	0.23	0.18	0.23		
Kenya	Coffee	0.19	0.39	0.19	0.39	0.03	0.07
Liberia	Rubber	0.13	0.17	0.15	0.20		
Madagascar	Coffee						
Malawi	Tobacco	0.13	0.28	0.13	0.28	0.09	0.20
Mali	Cotton	0.07	0.10	0.07	0.10	0.04	0.06
Mozambique	Cotton						
Niger	Groundnuts	0.08	0.11	0.08	0.11		
Nigeria	Cocoa	0.14	0.11	0.11	0.08		
Rwanda	Coffee	0.11	0.14	0.11	0.14		
Senegal	Groundnuts					0.08	0.12
Sierra Leone	Coffee	0.17	0.26	0.17	0.26		
Somalia	Bananas			0.05	0.06		
Sudan	Cotton	0.12	0.20	0.12	0.20	0.06	0.10
Tanzania	Coffee	0.31	0.42	0.16	0.23	0.08	0.11
Togo	Coffee	0.05	0.12	0.07	0.14		
Uganda	Coffee						
Zaire	Coffee			0.05	0.12	0.01	0.02
Zambia	Cotton	0.06	0.13	0.06	0.13	0.02	0.03
Zimbabwe	Tobacco	0.09	0.14	0.09	0.14	0.04	0.07

Annex D Table 8. Ratio of implicit financial outflow from agriculture (1980-85 average, in percent)

Country	To total government expenditure in agriculture	To total government revenue	To total government tax revenue	To agricultural GDP
Benin		0.55		0.18
Burkina Faso	49.58	2.41	2.82	0.92
Burundi		15.69	17.03	4.06
Cameroon	86.65	4.67	5.18	4.21
CAR	68.79 a			4.04
Congo		0.32		1.37
Cote d' Ivoire	450.05	17.86	22.20	17.80
Ethiopia	22.68	3.36	4.41	1.65
Gambia	13.95	3.14	3.50	2.16
Ghana	420.54	47.07	55.23	7.39
Guinea		-0.39		-0.26
Kenya	15.12	1.78	2.01	1.39
Liberia	74.19	6.29	6.56	4.06
Madagascar	204.05	22.38	28.63	8.80
Malawi	25.00	4.70	5.50	2.90
Mali	37.33	3.94	4.60	0.94
Mozambique				
Niger	-0.01	0.00		0.00
Nigeria	2.57	0.16	0.02	0.08
Rwanda	135.87	11.08		3.17
Senegal	4.57 a	0.42	5.12	0.43
Sierra Leone	93.94	13.12	0.02	3.54
Somalia	14.89	0.89	15.12	0.13
Sudan	-25.05 a	-3.28	-1.28	-1.29
Tanzania	56.35	6.83		7.47
Togo	101.35 a	8.18	61.62	8.20
Uganda	19.80	1.20	0.97	0.14
Zaire	124.38 a	6.41	1.84	3.02
Zambia	1.19	0.25	0.02	0.41
Zimbabwe	-0.47	-0.05	-0.09	-0.13

Note: Implicit financial outflows are the estimated unit transfers based on the nominal protection coefficients weighted by total export quantities.

a. Estimated Government expenditures in agriculture were available for entire 1980-85 period.

Annex D table 9. Weather variable (deviation from trend of cereal yields, in logarithms)

Coun.	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Benin	-0.052	-0.147	-0.120	0.078	0.091	0.115	0.079	0.105	0.073	0.032	0.013	-0.094	-0.116	-0.211	0.056	0.098	0.092	-0.092
Botswana	-1.828	0.173	0.966	-0.226	0.736	0.342	0.750	0.346	-0.068	-0.865	-0.116	0.099	0.154	0.103	-0.503	-0.084	-0.156	0.177
Burkina Faso	0.138	-0.037	-0.025	-0.104	0.001	0.092	-0.044	-0.011	0.050	0.032	-0.010	-0.023	-0.082	-0.186	-0.075	0.085	0.145	0.033
Burundi	0.031	-0.123	0.010	0.003	0.056	-0.004	0.006	-0.046	0.089	0.052	-0.030	0.093	-0.005	-0.060	-0.120	-0.015	0.026	0.033
Cemeroon	-0.013	-0.017	-0.009	-0.083	0.075	0.211	0.000	-0.015	-0.058	-0.104	-0.037	-0.059	-0.025	0.094	0.027	0.027	0.004	-0.019
Cape Verde	0.385	0.304	-0.221	-1.275	0.141	0.539	0.473	0.184	0.523	-1.334	0.334	-0.011	-0.051	-0.249	-0.068	-0.343	0.229	0.439
Chad	0.179	0.079	-0.189	-0.122	0.115	0.012	-0.107	-0.078	-0.056	0.031	-0.015	0.188	0.209	-0.163	-0.322	0.117	0.113	0.007
Congo	0.122	0.211	0.168	-0.087	-0.028	-0.095	-0.074	-0.039	-0.383	0.023	0.181	-0.235	-0.093	-0.070	-0.050	0.027	0.201	0.221
Cote d'Ivoire	0.015	0.197	-0.004	0.010	0.055	-0.025	-0.125	-0.125	-0.132	-0.159	0.063	0.037	0.088	-0.109	0.101	0.134	-0.042	0.022
C.A.R.	0.128	0.149	0.126	0.114	-0.165	-0.119	-0.117	-0.115	0.031	-0.144	-0.087	-0.021	-0.024	-0.041	-0.064	0.093	0.122	0.155
Ethiopia	-0.010	-0.024	-0.074	-0.114	-0.095	0.107	0.050	-0.096	0.107	0.150	0.121	0.070	0.189	0.037	-0.240	-0.133	0.071	-0.116
Gabon	-0.030	-0.032	-0.001	0.013	-0.015	-0.084	-0.022	-0.007	-0.014	0.178	0.102	0.069	0.031	0.021	-0.041	-0.083	-0.052	-0.054
Gambia	0.142	0.132	0.057	0.058	0.071	-0.096	-0.151	-0.317	0.021	-0.159	0.053	0.100	0.036	-0.229	-0.222	0.123	0.148	0.233
Ghana	0.012	0.019	0.031	0.031	0.138	0.004	-0.013	0.010	0.020	0.032	-0.126	0.059	-0.199	-0.780	0.127	0.204	0.212	0.220
Guinea	-0.062	-0.022	-0.012	0.005	0.013	0.018	0.024	0.024	0.034	0.029	0.053	0.061	0.068	-0.124	-0.105	-0.101	0.051	0.049
Guinea-Bisseu	0.208	0.015	0.090	-0.012	-0.097	0.094	0.117	-0.208	-0.140	-0.173	-0.140	0.064	-0.095	-0.125	-0.091	0.167	0.131	0.195
Kenya	0.014	-0.016	0.022	0.026	-0.010	0.089	0.050	0.023	-0.079	-0.180	-0.217	0.007	0.227	0.056	-0.163	0.097	0.176	-0.122
Lesotho	-0.217	0.012	-0.452	-0.253	0.179	-0.083	-0.181	0.671	0.594	0.382	0.206	0.058	-0.170	-0.152	-0.203	-0.102	-0.166	-0.125
Liberia	0.003	0.003	0.003	0.004	0.001	-0.028	-0.006	0.008	0.019	0.004	-0.001	0.002	-0.037	-0.005	0.027	-0.005	0.023	-0.017
Madagascar	0.040	0.008	0.014	-0.014	0.026	0.003	0.055	-0.027	-0.069	-0.025	-0.025	-0.058	-0.072	0.013	0.003	0.032	0.027	0.068
Malai	0.066	0.084	-0.110	-0.135	0.029	0.126	-0.138	-0.240	0.315	0.071	-0.146	0.052	0.015	0.065	-0.147	0.044	0.091	-0.062
Malawi	-0.197	0.042	0.051	0.00	0.026	-0.069	-0.004	0.148	0.087	0.053	-0.073	-0.004	0.026	0.066	0.040	-0.038	-0.069	-0.091
Mauritania	0.283	-0.271	-0.305	-0.319	0.052	0.281	0.482	0.135	-0.146	-0.308	0.123	0.219	-0.144	0.139	-0.130	0.093	-0.153	-0.029
Mauritius	0.068	0.323	0.171	0.162	-0.010	-0.254	-0.047	-0.074	-0.200	-0.205	-0.265	-0.226	-0.276	-0.120	0.237	0.279	0.183	0.235
Mozambique	0.097	0.062	0.128	0.039	-0.051	-0.333	0.034	0.036	-0.023	-0.129	-0.010	-0.002	-0.026	-0.007	0.019	0.060	0.127	-0.020
Niger	-0.041	0.048	0.029	-0.217	0.015	-0.143	0.061	0.083	0.081	0.126	0.153	0.060	0.025	0.046	-0.401	0.098	0.081	-0.103
Nigeria	0.003	-0.048	-0.165	-0.110	0.194	0.137	-0.160	0.057	-0.041	0.088	0.234	0.082	-0.048	-0.077	-0.075	0.007	0.034	-0.114
Rwanda	0.065	0.016	0.003	-0.020	-0.140	-0.007	0.008	0.014	0.012	-0.019	0.084	-0.014	0.082	0.021	-0.087	-0.068	0.034	0.016
Senegal	-0.096	0.202	-0.390	-0.089	0.256	0.189	0.164	-0.189	0.283	-0.039	-0.182	0.087	-0.004	-0.204	-0.160	0.109	-0.137	0.230
Sierra Leone	0.008	-0.047	0.001	-0.010	0.012	0.075	0.038	0.045	0.039	-0.114	-0.107	-0.109	0.030	0.139	0.104	-0.125	0.039	-0.016
Somalia	0.003	0.011	0.011	-0.002	0.023	0.030	-0.056	0.011	0.021	0.027	0.038	0.001	0.002	-0.399	-0.040	0.222	0.072	0.027
Sudan	-0.016	0.056	-0.148	-0.144	-0.092	0.083	-0.015	0.097	0.224	-0.071	0.168	0.378	-0.068	-0.132	-0.514	0.154	0.191	-0.153
Swaziland	-0.673	0.240	0.316	-0.099	0.190	0.095	0.127	0.019	0.326	-0.300	0.053	0.249	-0.380	-0.606	0.307	0.007	0.057	0.075
Tanzania	0.002	-0.042	-0.050	-0.126	-0.136	0.144	0.128	0.110	0.008	0.057	0.060	0.005	0.020	-0.073	-0.013	0.006	0.130	-0.065
Togo	-0.090	0.024	0.106	-0.009	0.067	0.129	-0.017	0.007	-0.094	-0.002	-0.252	-0.106	0.077	-0.087	0.121	0.069	0.013	0.024
Uganda	0.011	-0.123	-0.003	-0.050	-0.135	0.088	-0.018	-0.029	-0.094	0.259	0.178	0.223	0.256	0.230	-0.492	-0.433	0.048	0.066
Zaire	0.028	0.013	0.029	0.009	-0.001	-0.009	-0.024	-0.045	-0.072	0.011	-0.020	0.029	0.013	0.018	0.005	-0.013	0.004	0.027
Zambia	-0.295	-0.033	0.053	-0.183	-0.093	0.158	0.153	0.169	0.143	0.081	0.067	0.204	-0.032	-0.036	-0.092	-0.043	0.072	-0.314
Zimbabwe	-0.333	0.081	0.231	-0.293	0.151	0.071	0.100	0.169	0.110	-0.069	-0.048	0.370	-0.049	-0.624	-0.396	0.469	0.380	-0.301

Annex D table 10. "Disasters" data: number of people affected by major disasters, in thousands.

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Angola	0	0	0	0	0	160	160	0	0	0	0	661	0	0	0	500	0	1
Benin	0	0	115	0	0	0	0	0	4	0	0	0	500	250	0	350	375	0
Rwanda	88	0	1	0	0	0	0	0	0	0	0	0	410	410	1037	880	648	671
Burkina Faso	0	0	0	1300	0	0	0	0	442	2	0	4	7	0	2502	0	0	0
Burundi	0	0	600	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
Cameroon	0	400	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0
Cape Verde	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	6	0	0
C.A.R.	0	0	0	13	0	0	0	0	0	500	0		0	0	0	0	0	0
Chad	0	10	0	900	0	0	0	1900	0	475	1500	1500	1700	600	1503	0	0	0
Comoros	0	0	0	0	0	0	0	35	0	0	0	0	0	30	0	35	0	0
Congo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cote d'Ivoire	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Equat. Guinea	0	0	0	0	0	0	0	0	0	250	0	0	0	0	0	0	0	0
Ethiopia	1700	5	0	1550	1550	0	50	950	1417	0	25	0	0	2000	5000	8051	0	7330
Gabon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gambia	0	150	0	0	0	0	0	0	85	0	500	301	0	0	0	0	0	0
Ghana	0	12	0	0	0	0	0	7	0	0	0	0	0	13200	0	2	0	0
Guinea	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0
Guinea-Bissau	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Kenya	0	150	0	0	0	0	16	20	0	0	40	0	4	13	600	0	0	0
Lesotho	0	0	0	0	1	0	0	0	0	0	0	0	0	0	500	80	0	0
Liberia	0	0	0	0	0	0	0	0	1	204	2	0	0	0	0	0	0	0
Madagascar	10	0	2500	0	0	10	500	30	0	18	0	1000	118	0	114	0	84	28
Malawi	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	715
Mali	0	0	0	1900	0	0	0	0	0	0	0	5	0	0	1503	1503	0	0
Mauritania	0	0	0	1300	0	0	0	710	710	27	0	0	0	850	1653	800	0	0
Mauritius	0	0	25	0	0	826	0	0	0	0	100	0	32	0	0	0	0	0
Mozambique	0	501	0	0	13	87	0	400	200	80	0	6006	0	4000	5010	3066	0	6580
Niger	3	0	0	1600	8	8	0	0	0	0	0	0	3	67	3500	0	0	0
Nigeria	82	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2
Rwanda	0	0	0	3	950	950	0	1700	1	1	0	0	0	0	0	420	0	0
Sao Tome & Principe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	93	0	0	0
Senegal	0	0	0	1400	0	0	0	0	3715	0	950	0	0	605	600	0	3	0
Seychelles	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sierra Leone	0	0	0	0	0	5	5	0	0	0	0	0	0	0	0	0	3	0
Somalia	30	0	0	0	124	125	0	173	20	0	0	20	0	0	0	6	8	501
Sudan	0	0	0	680	0	75	70	0	100	0	0	0	0	140	5202	4200	2000	0
Swaziland	0	0	0	0	0	0	0	0	0	0	0	0	0	1	632	0	0	0
Tanzania	0	0	0	0	0	0	0	20	16	90	0	0	40	0	0	1900	0	0
Togo	200	150	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0
Uganda	0	0	0	0	0	0	0	0	0	400	500	0	0	150	0	0	1000	331
Zaire	0	0	0	0	0	0	1	8	61	500	160	0	0	0	300	0	0	0
Zambia	0	1	0	0	0	0	0	0	30	1	11	12	0	0	0	0	0	0
Zimbabwe	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0

SOURCE: USAID, May 1988. "Disaster History." Office of U.S. Foreign Disaster Assistance.

Annex D Table 11. Food Crop Price and Policy Effects

	Real producer prices (index 1979-81 = 100)			Nominal protection coefficients		
	Average 1970-72	Average 1975-77	Average 1985-87	Average 1970-72	Average 1975-77	Average 1985-87
Benin		108				
Botswana		87	136	0.89	0.66	1.2
Burkina Faso	66	89	85			
Burundi	123	104				
Cameroon	89	98				
C.A.R.	107	115				
Chad						
Congo		90	96			
Cote d'Ivoire	120	20/	93	0.73	1.04	
Ethiopia	219	181	85			
Gambia	71	117	74			
Ghana	84	138	93	0.93	3.32	1.89
Guinea	30	114				
Guinea-Bissau						
Kenya	105	134	104	0.63	0.79	0.93
Liberia	59	96	80	0.86	1.38	2.43
Madagascar	80	113	172	0.53	0.7	1.06
Malawi	95	101	94	10.92	4.58	1.49
Mali	98	96	109			0.58
Mauritania						
Mozambique						
Niger	71	91				
Nigeria	140	101	92			
Rwanda	140	102	92	0.59	0.66	1.27
Senegal	103	106	88			
Sierra Leone	71	91				
Somalia	181	142	159			1.32
Sudan	66	88		1.03	1.24	1.34
Tanzania	72	130	109			1.58
Togo		139	88		1.7	1.62
Uganda	299	202				
Zaire						
Zambia	83	84	139	0.68	0.61	0.68
Zimbabwe	76	84	94	0.37	0.36	0.62

Annex D Table 12. Comparison of domestic staple food prices to imported rice and wheat prices

Country	Crop	As a fraction of international rice price			As of fraction of international wheat price		
		1970-72	1980-82	1985-87	1970-72	1980-82	1985-87
Burkina Faso	sorghum	0.58	0.79		1.31	2.08	
	maize	0.58	0.79		1.31	2.08	
Cameroon	maize	0.99	1.08		2.23	2.86	
	cassava	0.36	0.33		0.82	0.88	
	plantains	0.53	0.69		1.19	1.83	
Cote d'Ivoire	maize	1.25	1.29		2.80	3.43	
	cassava	0.93	1.25		2.09	3.32	
	yams	0.92	1.19		2.07	3.15	
Ghana	maize	1.02	6.88	1.92	2.28	18.26	3.52
	cassava	0.42	3.43	1.10	0.95	9.09	2.01
Kenya	maize	0.56	0.70		1.27	1.85	
Malawi	maize	0.32	0.27	0.41	0.72	0.71	0.75
Mali	sorghum	0.75	0.86	1.22	1.69	2.29	2.24
Niger	sorghum	0.75	1.32		1.69	3.50	
Togo	maize	0.72	0.80		1.61	2.12	
	sorghum	0.80	0.64		1.79	1.69	
Senegal	sorghum	1.00	0.74	1.54	2.25	1.97	2.83
Zambia	maize	0.60	0.60		1.35	1.60	
Zimbabwe	maize	0.47	0.43	0.65	1.06	1.15	1.18

Annex D Table 13. Various Specifications of Regression Equation for Agricultural Supply.

Dependant variable = agricultural exports

Model	All countries			Tree crop exporters			Annual crop exporters
Producer Price							
Crop year (t)	0.08 (2.38)	0.075 (6.81)		0.008 (1.38)	-6.001 (-0.062)		0.560 (4.00)
Lagged moving average (t-2 to t-4)	0.150 (4.27)			-0.062 (-4.67)			
Five year moving average (t to t-4)			0.303 (8.30)			0.091 (20.4)	
Real effective exchange rate							
Crop year (t)	0.002 (0.087)	-0.190 (-5.56)		-0.140 (-9.4)	-0.168 (-9.45)		0.250 (1.79)
Lagged moving average (t-2 to t-4)	-0.173 (-4.31)			-0.210 (-10.07)			
Disasters variable	-0.0016 (-2.64)	-0.0009 (-4.54)	-0.0011 (-1.67)	-0.0042 (-11.27)	-0.0011 (-1.19)	-0.0058 (-60.6)	0.0022 (1.65)
Weather variable	0.372 (18.9)	0.405 (25.5)	0.404 (19.1)	0.184 (14.3)	0.167 (5.06)	0.242 (33.9)	0.46 (5.66)
Intercept	4.33 (11.95)	3.10 (18.5)	6.33 (31.1)	5.40 (39.6)	3.98 (172)	6.81 (0.91)	
Degrees of freedom	287		189	233		97	

Note: Exports, producer prices, exchange rate, and the rainfall variable have been expressed in logarithms. Their coefficients may be interpreted as elasticities.

Figures in parentheses are t-values.

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